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## Research Report

SC-RR-69-572

December 1969

### CLIMATOLOGY OF AIRBLAST PROPAGATIONS FROM NEVADA TEST SITE NUCLEAR AIRBURSTS

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ABSTRACT

Microbarograph data from Nevada atmospheric nuclear tests of 1951-1962 have been assembled to show climatological patterns for long range propagations. Amplitudes have been normalized to 1-kiloton yield, free-airburst, after actual height-of-burst effects were removed.

On-site propagations under early morning inversions often showed double the amplitudes expected for standard hemispherical wave expansion. These enhanced blasts were blocked by mountains and did not penetrate off-site. Strong winds at higher altitudes gave as much as 5X blast magnifications at Indian Springs and Las Vegas.

Ducting at very high altitude, to 30 miles or 150,000 feet, is seasonally directed eastward in winter, westward in summer. Resulting amplitudes in the sound ring near 135 miles range show as large as 3X magnification downwind and 0.006X reduction upwind. On the average the annual cycling in east and west directions ranges from near standard, 1X, downwind amplitudes to 0.016X upwind amplitudes. The seasonal reversal periods when upper winds are nearly calm, occur about May 5 and September 20. At that time amplitudes in all directions shown an average 0.28X reduction below standard.

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## CLIMATOLOGY OF AIRBLAST PROPAGATIONS FROM NEVADA TEST SITE NUCLEAR AIRBURSTS

### Introduction

Now that several years have elapsed since atmospheric nuclear tests were last conducted at the Nevada Test Site (NTS), recollections of the characteristics of long-range airblast propagations have dimmed. However, during this time there have been significant improvements in understanding these phenomena. A review of our collection of microbarograph (MB) amplitudes is now appropriate in light of current concern over propagations predicted for the escalating yields of Plowshare cratering experiments.

This review will not go into detailed analysis or case studies. The main point is to present yield data which have now been declassified,<sup>1</sup> and normalize it to a reference yield of a 1-kiloton nuclear explosive (NE) free-airburst (FAB). Bursts at various heights above ground—on towers, on balloons, or from bombs dropped from airplanes—may have enhanced blast pressures where the ground-reflected shock overtakes and combines with the incident shock wave. This is described in *The Effects of Nuclear Weapons*,<sup>2</sup> and this fused shock, called the Mach stem, has higher overpressures which depend upon burst height, yield, and distance.

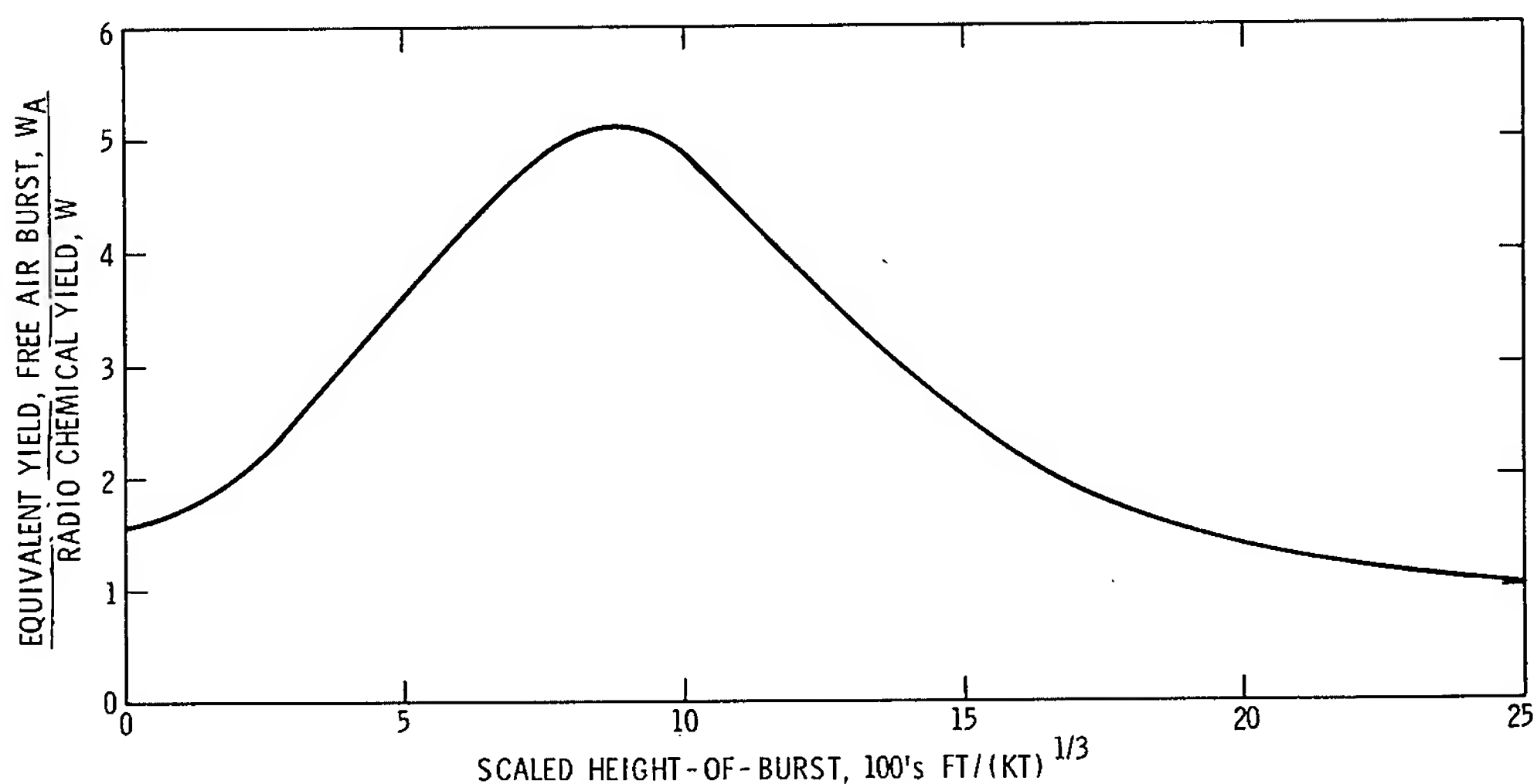


Figure 1. Height-of-Burst Effect on Airblasts from Nuclear Tests

Height-of-burst (HOB) effects have been removed from mb data by assuming that Mach stem wave strengths could be simulated by larger apparent yields,  $W_A$ . Actual burst height divided by the cube root of the radiochemical yield,  $W^{1/3}$ , gives scaled HOB. A function relating apparent yield enhancement to scaled HOB was generated from curves of HOB effects at the  $\Delta p = 2 \text{ lb/in.}^2$  overpressure contour, and is shown in Figure 1. Experiment has shown<sup>3</sup> that these blast enhancements are carried to long ranges. Note that surface bursts are not exactly constrained to the model of a hemisphere and a perfectly reflecting plate,  $W_A/W = 2$ , because much energy is absorbed in cratering and ground shock. The "optimum" HOB for 1 kiloton is near 900 feet.

It was further assumed that wave overpressures and amplitudes decay inversely with distance,  $R$ , raised to the 1.2 power. The difference between  $R^{-1.2}$  decay and acoustic  $R^{-1}$  decay is attributed to losses observed by experiments with unrefracted propagations. Distances to constant blast pressure are scaled in proportion to  $W^{1/3}$ , and the result is, for power law decay, that, at a fixed distance, amplitudes increase in proportion to  $W^{0.4}$ .

Reported yields and HOB's have been used to calculate  $W_A$  and  $W_A^{0.4}$  for each event, and each microbarogram amplitude has been appropriately reduced to  $W_A = 1$  kiloton, NE FAB. The standard incident overpressure curve for this explosion yield at sea level ambient pressure,  $p = 1000 \text{ mb}$ , and at  $R \geq 9000$  feet, is

$$\Delta p \text{ mb} = 357 (R \text{ kilofeet})^{-1.2} ; \quad (1)$$

and for the altitude of NTS, using the CP-1 (Yucca Pass Control Point) elevation of 4144 feet MSL, standard pressure altitude  $p = 870 \text{ mb}$ , is

$$\Delta p \text{ mb} = 328 (R \text{ kilofeet})^{-1.2} . \quad (2)$$

Peak-to-peak incident amplitude,  $p_k$ , used because it averages out some of the deviations, uncertainties, and nonrepeatabilities in both positive and negative phases at long range, is obtained by multiplying  $\Delta p$  at NTS altitude by 1.35 (from IBM Problem M),<sup>4</sup> so that

$$p_k \text{ mb} = 444 (R \text{ kilofeet})^{-1.2} . \quad (3)$$

In the distant field, ozonosphere signals often strike ground at relatively large incidence angles of up to 40 degrees above horizontal. They are nearly doubled by reflection because the ground is a near-perfect reflector of these wavelengths. Consequently,

reference curves for ozonosphere signals will be recorded, reflected amplitudes,  $p_k^*$ , where

$$p_k^* \text{ mb} = 888 (R \text{ kilofeet})^{-1.2} . \quad (4)$$

### Troposphere Propagations

There are three paths for blast waves propagating to long range through the troposphere. One, when sound velocity decreases with altitude, is called the gradient situation, and wave rays are turned upward away from ground. No acoustic rays reach ground outside the range of direct rays from elevated bursts. Some blast energy scatters out into this "silent" area, however, and gives detectable amplitudes from large nuclear explosions even at long range. The pressure-distance decay rate is very rapid.

A second possible wave path is under a near-surface inversion which may generate from nighttime cooling in the air near ground level. A sound velocity inversion may also result from wind direction or velocity shears with height. For early morning shot times at NTS this was a normal ducting mode, as far as propagations through Yucca or Frenchman's Flats were concerned. Mountains usually prevented this ducting from spreading out with large amplitudes into surrounding communities.

The third path, and the one which caused concern for off-site safety from nuclear tests, is ducted downwind by jet stream or other high-wind speeds. This condition may cause considerable blast magnification at ranges up to 100 miles.

There has been no attempt to separate these modes of propagation in the data assemblages of Figures 2 through 5. In these figures points are connected where they represent stations in a general line, often toward Las Vegas, from the shot point. Some isolated points show values at other azimuths which do not conform to the pattern for other directions. Data from 11 events of Operation Upshot-Knothole are shown in Figure 2. Figure 3 presents data from events of Operation Teapot. Data from 23 Plumbbob and 17 Hardtack events are entered in Figures 3 and 4, respectively. In all of these figures there is too much overlap to allow clear identification of the curve for each event, so they have not been labeled. Microbarograph amplitude data are listed in the Appendix, if more detailed case studies are needed. It may be concluded that the low pressures and rapid decays with distance were associated with atmospheric gradient conditions for propagation. Very high amplitudes, in excess of standard at long range, were associated with ducting by high wind speeds at altitudes as high as 30,000 feet MSL. High pressures at

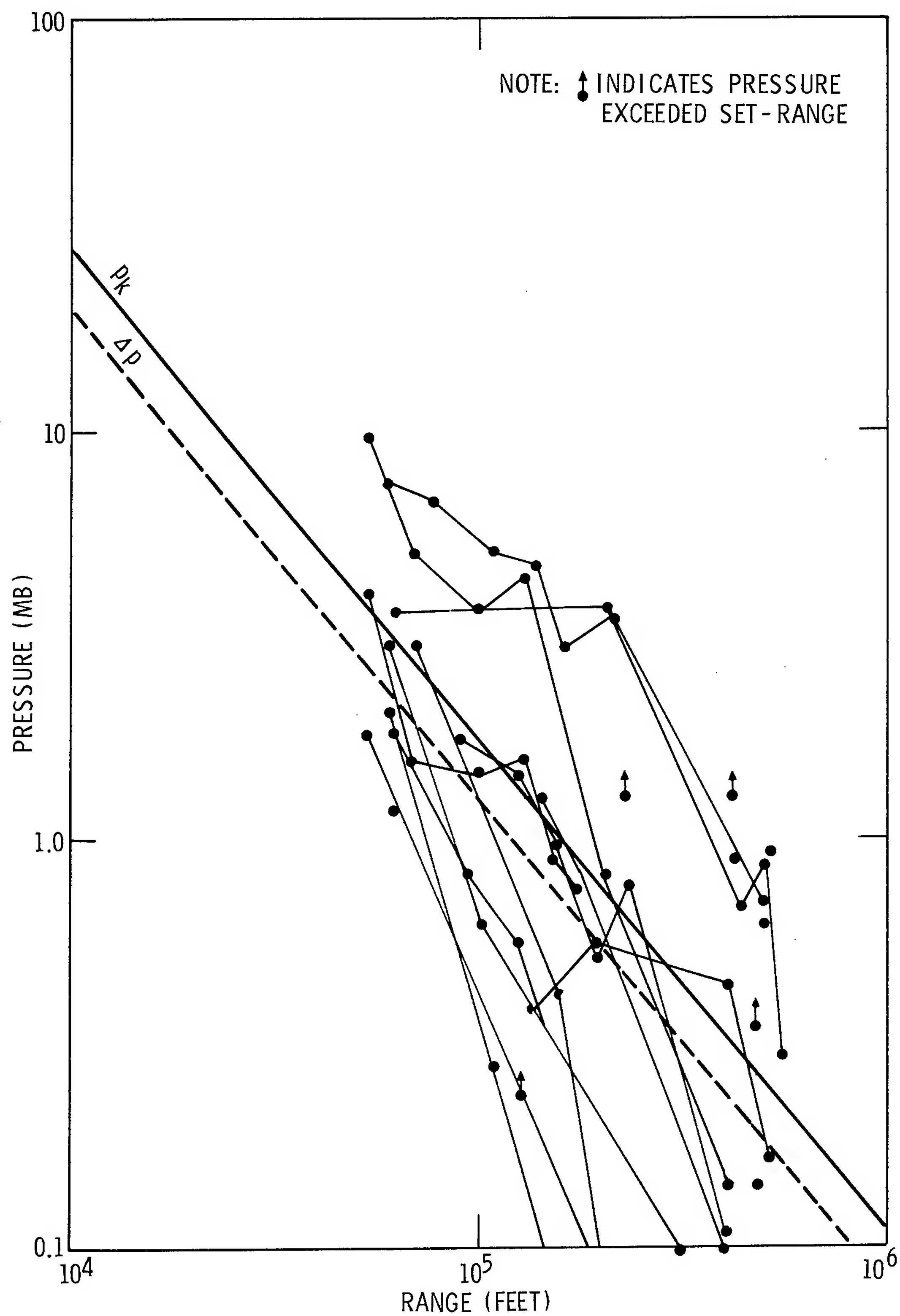


Figure 2. Summary of Troposphere Propagations, Upshot-Knothole, 3/17 - 6/4 1953

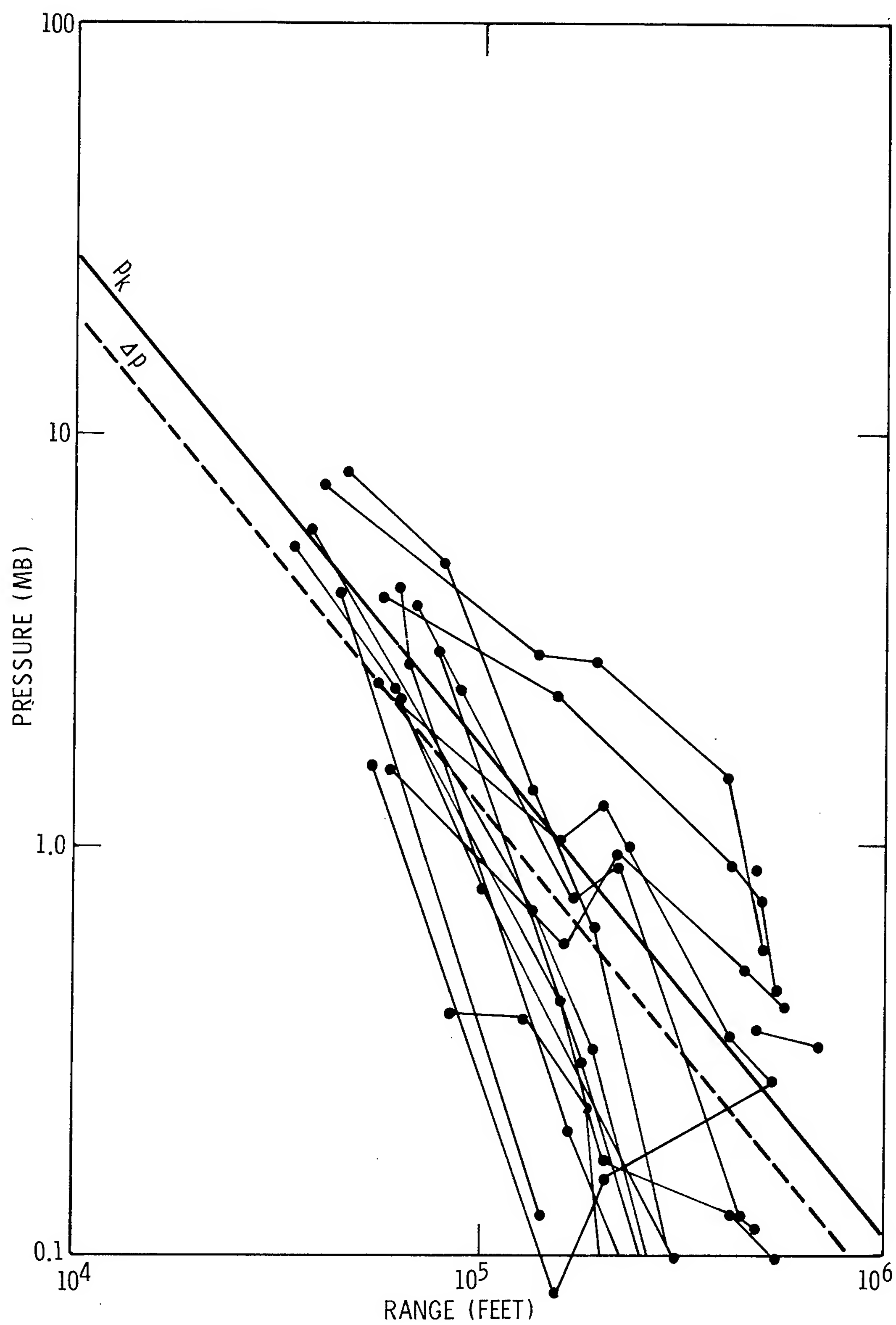


Figure 3. Summary of Troposphere Propagations, Teapot, 2/18 - 5/15 1955

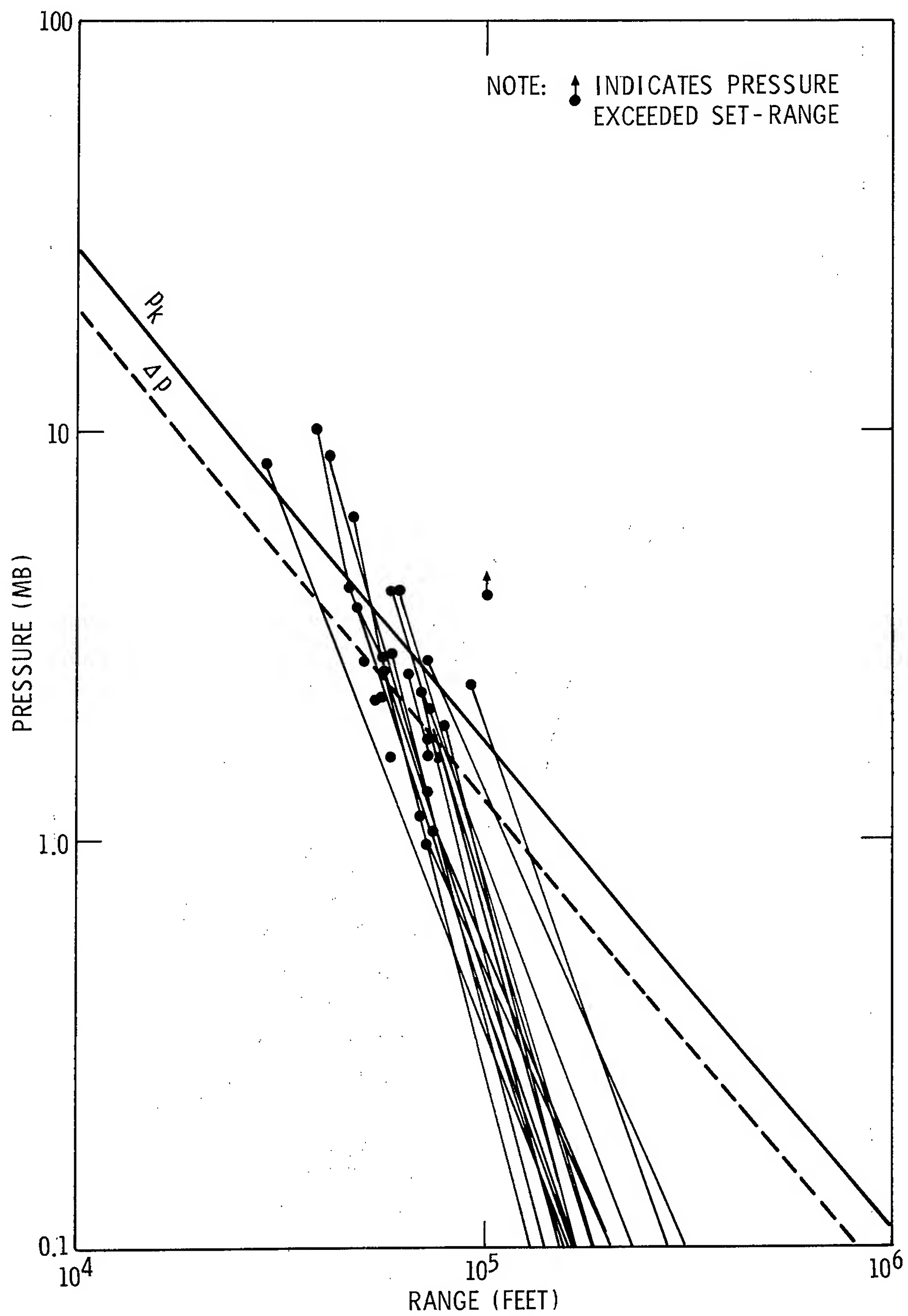


Figure 4. Summary of Troposphere Propagations, Plumbbob, 5/28 - 10/7 1957

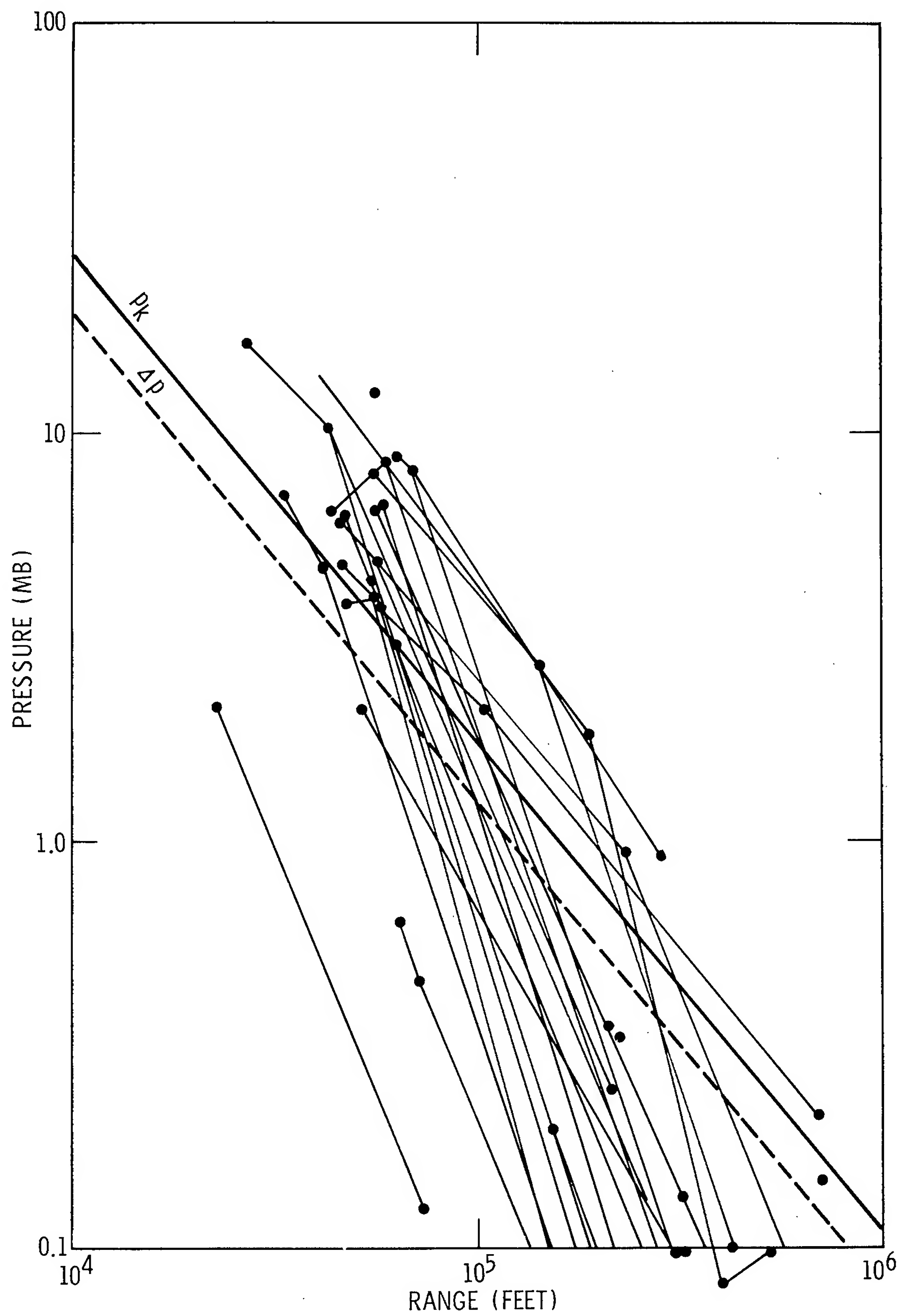


Figure 5. Summary of Troposphere Propagations, Hardtack II, 9/19 - 10/29 1958



intermediate ranges are attributable to surface inversion ducting. On occasion this extends to 40 miles. Beyond this intermediate range amplitudes drop rapidly with increased distance.

Large troposphere signal amplitudes were recorded at Las Vegas and Boulder City several times during Upshot-Knothole and Teapot. Jet streams are frequent visitors to Nevada skies during late winter and through the spring. The summer series, Plumbbob, had no case with even near-standard propagation into Las Vegas. This is as expected from consideration of atmospheric conditions with high surface temperatures, unstable temperature lapse rates, and relatively weak southwesterly summer winds aloft. During the autumn when Hardtack was conducted, there were a number of occasions of strong relative propagation, but shots in this series were mostly very small yields that resulted in no claims or damages. The one nominal-yield test which was planned was canceled lest it focus a strong airblast on Las Vegas, as was predicted by both ray trace calculations and numerous check shots of a ton or less high explosives.

Maximum propagations to long range through the troposphere reached magnifications of 5X, and were below the extremes found in the Blast Unit Research Project (BURP) experiment,<sup>5</sup> which was searching for foci. Lower maxima obtained from nuclear tests than from 1.2-ton HE bursts in BURP may show results from less scatter for long wavelengths. Alternatively and less comforting, it may reflect our concerted efforts to avoid firing nuclear tests under long range propagation conditions which could cause off-site damage and hazards.

Also interesting is the rapid decay of amplitude with distance in gradient conditions; this was particularly noticeable from Plumbbob data which had an average power-law decay near  $p_k^* \sim R^{-2.8}$ . This decay is faster than was usually observed from Pacific tests which were also fired in gradient conditions indigenous to tropical oceania. Faster decay at NTS may have been caused by the general land slope toward the southeast observing line, with propagation further refracted up and away from ground by higher temperatures at lower altitudes, as compared to propagation along the horizontal boundary plane of the sea.

The extreme minimum propagation curve in Hardtack can probably be discounted. It was recorded from the Vista event, a 24-ton burst on the surface. This small yield may be uncertain, and the  $W_A = 1.6 W$  assumption may well be in error. It is generally valid for large nuclear events and generally invalid for high explosives.<sup>6</sup>

With gradient conditions, where there is no acoustic amplitude calculation for propagation into the "silent" zone, a safety envelope can be constructed between the standard

curve at 100,000 feet and 0.1 mb at 300,000 feet. This would allow assurance that no windows would break ( $p_k^* \geq 4$  mb) from less than an 8-kiloton yield at 20 miles range, or from less than 10 megatons at 60 miles, from tropospheric propagation of midday or afternoon blasts with light wind speeds at all troposphere altitudes.

The upper envelope of empirical amplitudes shows that windows can be broken by 4-mb recorded amplitudes in Las Vegas by an apparent airburst yield of 9.9 kilotons, which could be generated by a 1.9-kiloton burst at 1100 feet above the surface.

### Ozonosphere Propagations

Above the tropopause, which is usually near 40,000 feet MSL, temperatures are nearly constant for a while, then increase with altitude to a maximum near  $0^\circ\text{C}$  at about 160,000 feet in the ozonosphere. Temperatures decrease again above this altitude to another minimum at the base of the ionosphere near 300,000 feet. The warm ozonosphere layer of relatively high sound speeds serves as a foundation for wind ducting. Wind speeds at these altitudes may exceed 150 mph and cause the sound or wave velocity in downwind directions to exceed the ground level value. This allows ducting and refractive ray bending so that the explosion wave is returned to ground at ranges of from 75 to 150 miles. These upper winds in temperate latitudes blow as seasonal monsoons from west to east in winter and from east to west in summer. In reversing in spring and fall, they become nearly calm for short periods of about two weeks.

Even with calm upper winds, the high temperature layer does serve as a source for wave scattering into the silent zone. A pressure oscillation is always recorded, even at 135 miles upwind, from kiloton or larger nuclear bursts. The result, either in the east or west, is an annual march of amplitudes of quasi-sinusoidal form. Large values occur during the downwind period and small values during the upwind season. The transition may be gradual or truncated, but the scatter in observed transition dates probably obscures the true form in these data, which have been obtained from a small (climatologically speaking) number of events.

Amplitudes from the various tests have been plotted by station in Figures 6 through 13. Bearings and distances to these various stations are listed in Table I. Identification of the graph symbols is given in a legend on Figure 6, St. George data. This figure has the most definitive seasonal data, since this station was the most regularly operated and it is near the right direction and range for maximum amplitude in the seasonal cycling.

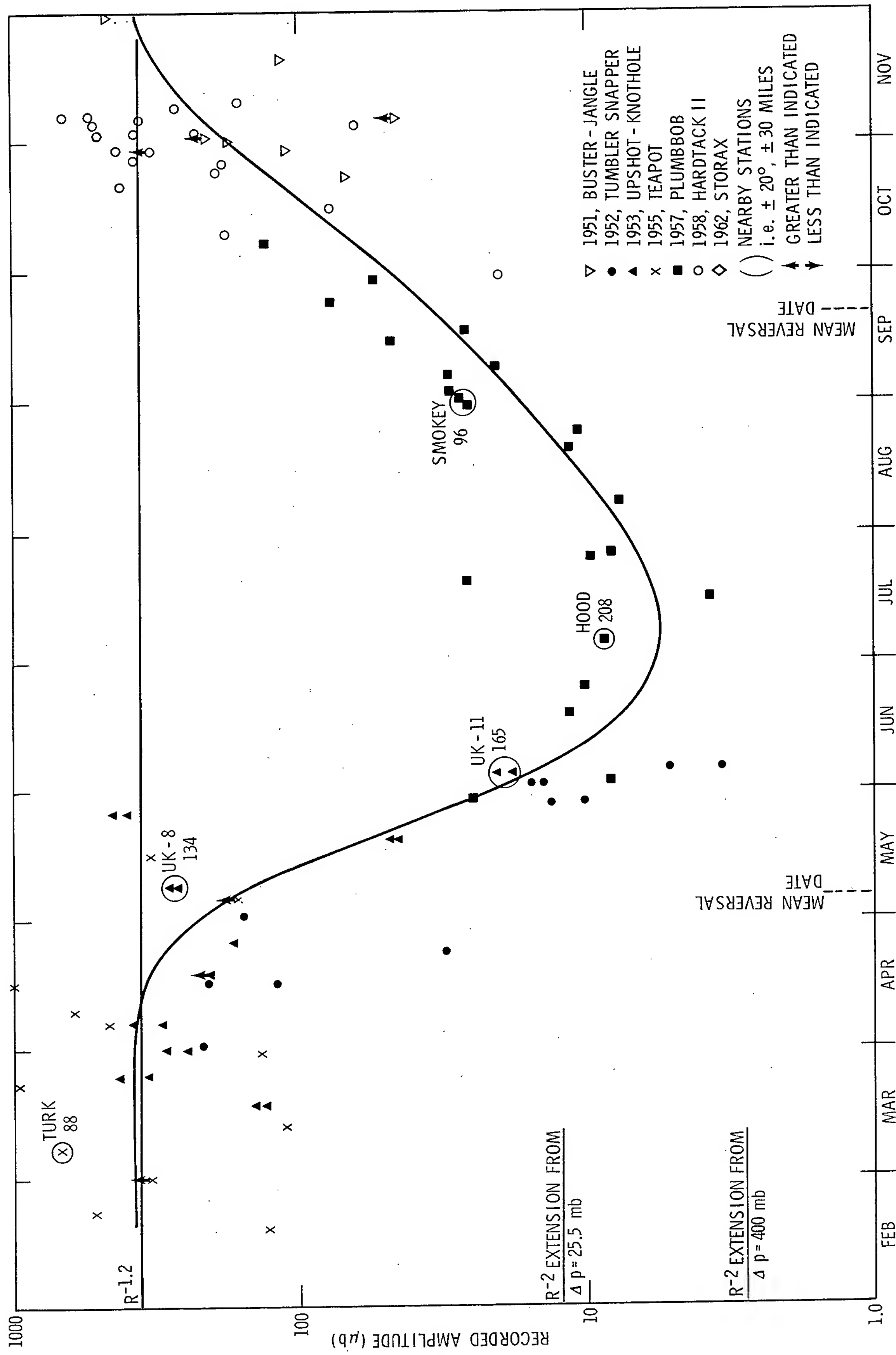


Figure 6. Ozonosphere Signal Amplitudes, St. George, Utah

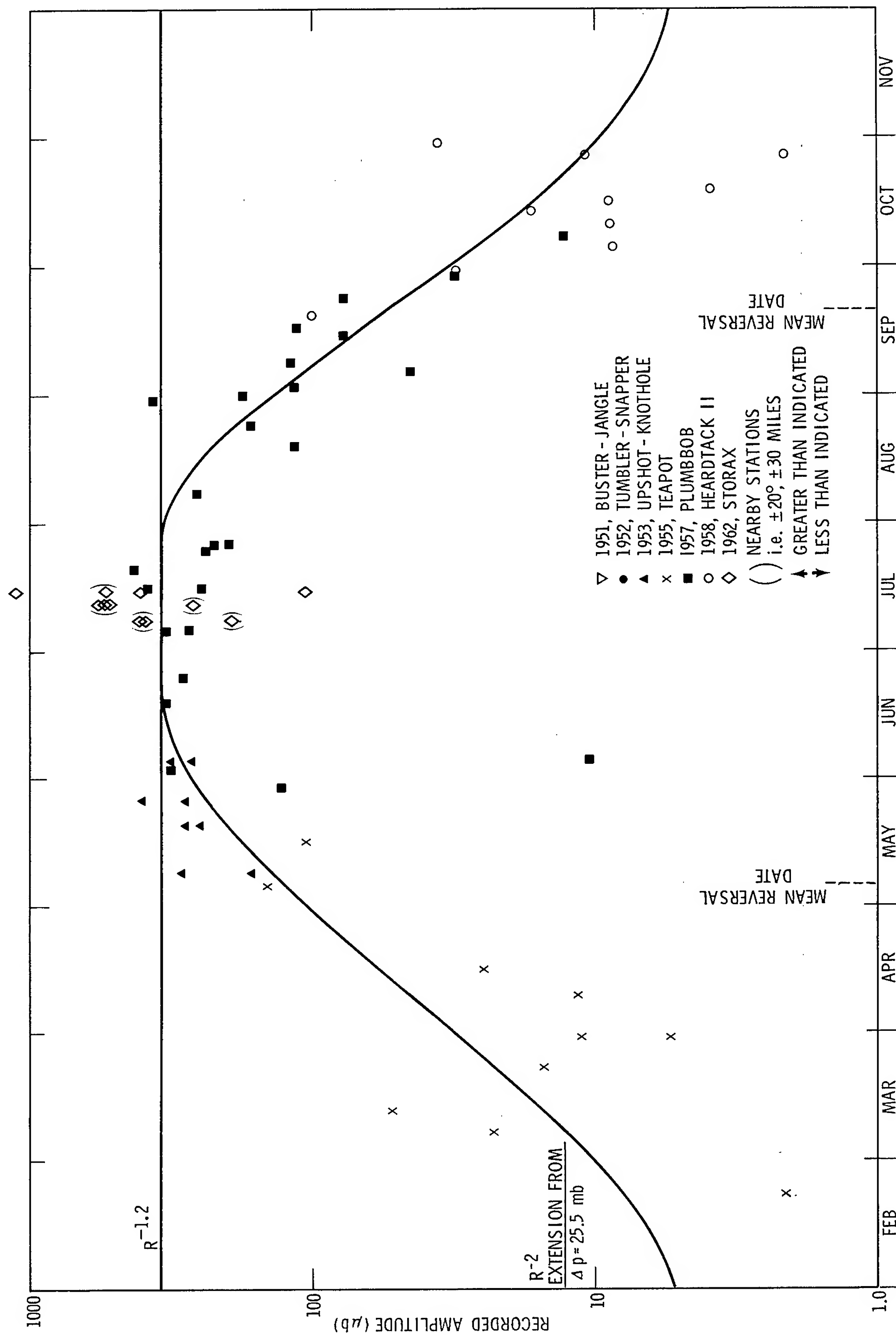


Figure 7. Ozonosphere Signal Amplitudes, Bishop, California

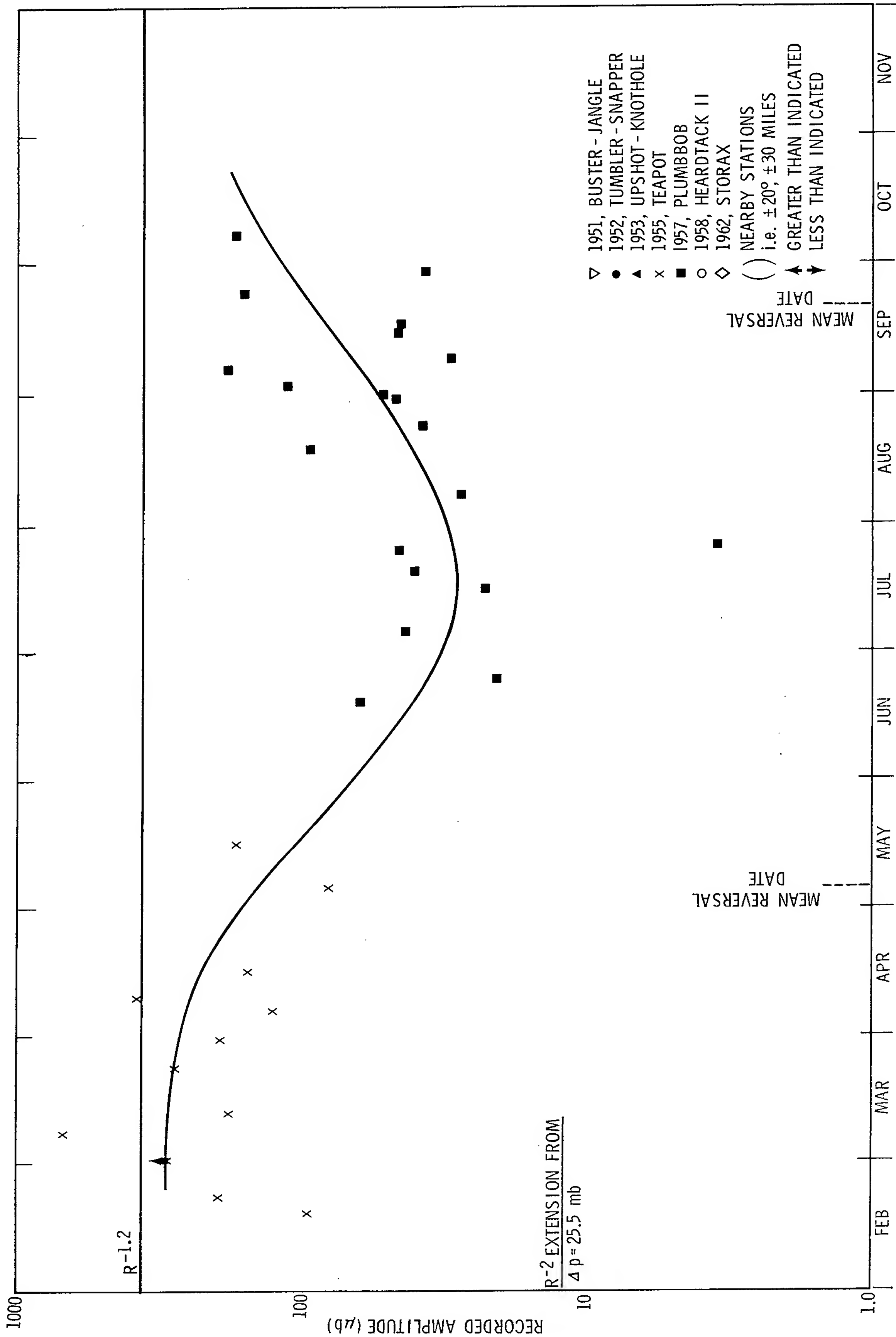


Figure 8. Ozonosphere Signal Amplitudes, Lund, Nevada

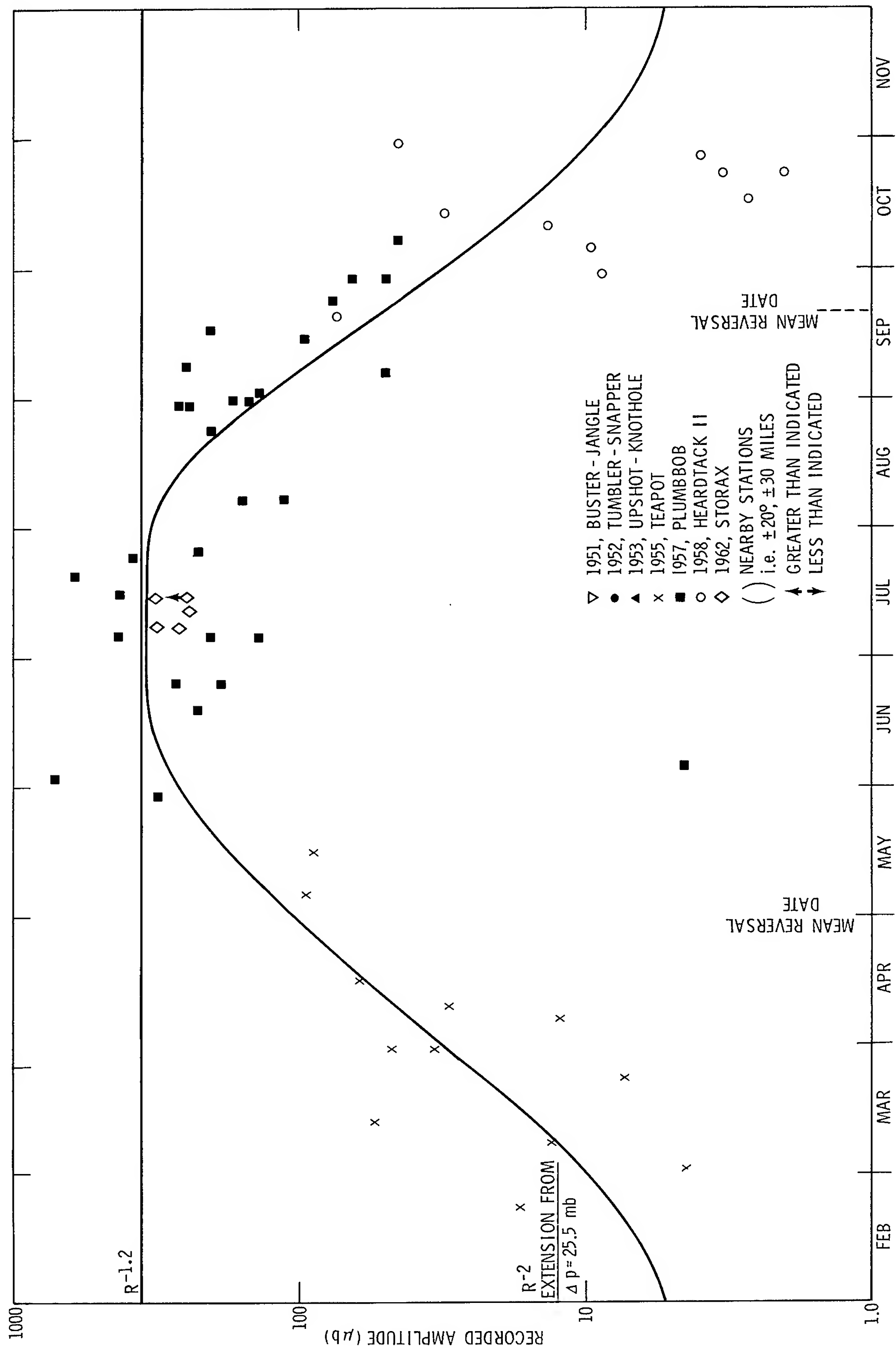


Figure 9. Ozonosphere Signal Amplitudes, China Lake, California

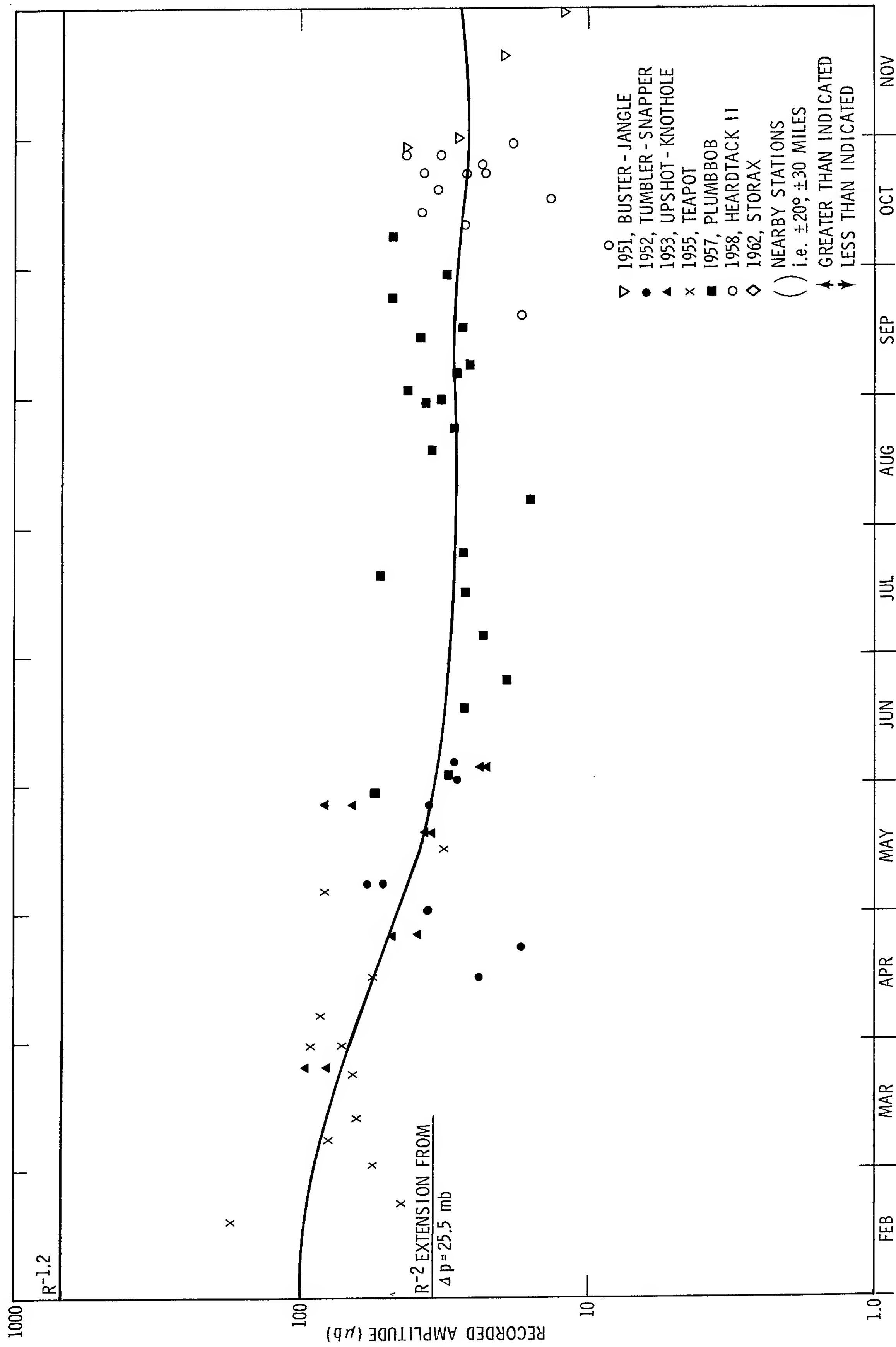


Figure 10. Ozonosphere Signal Amplitudes, Las Vegas, Nevada

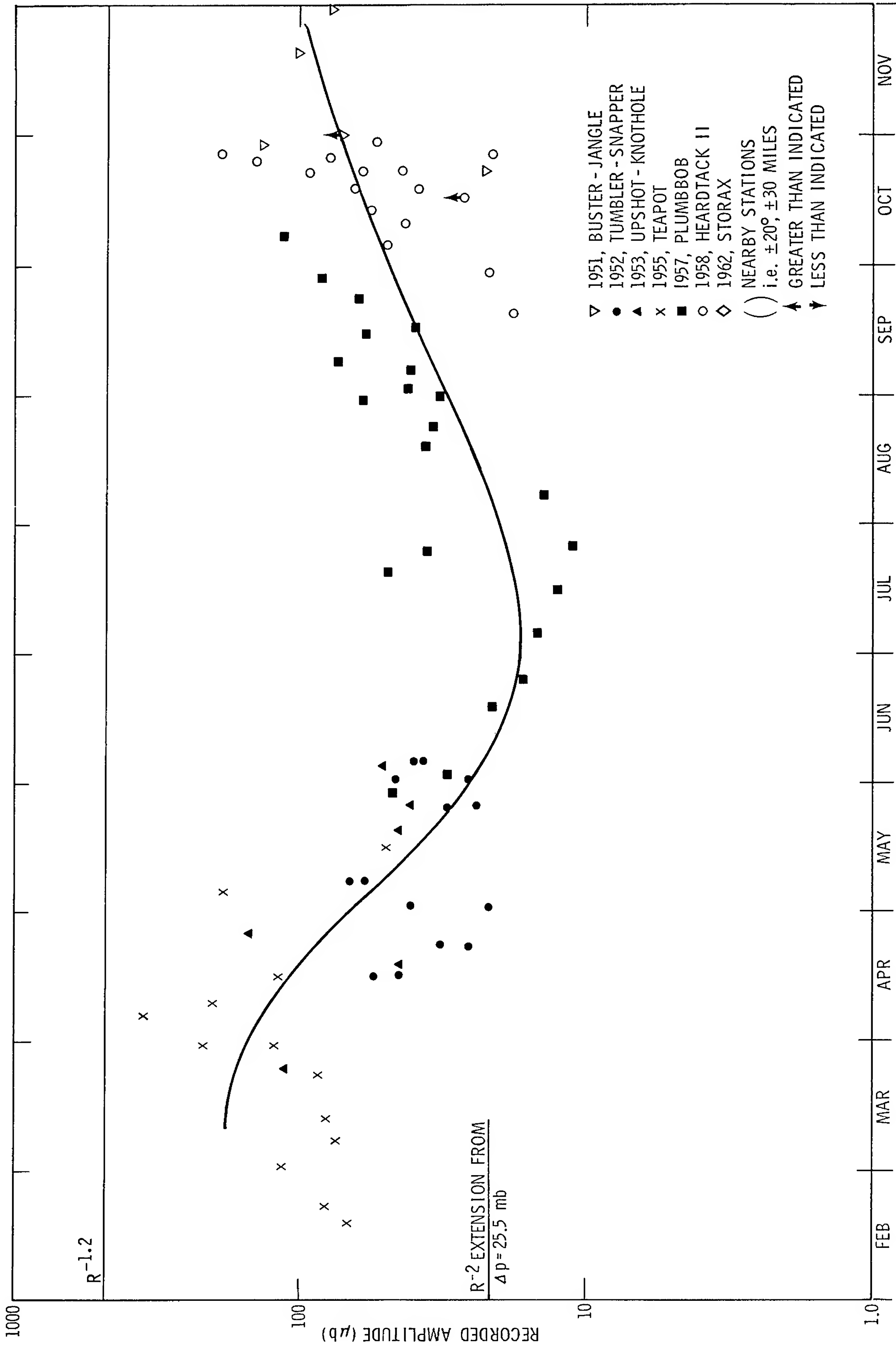


Figure 11. Ozonosphere Signal Amplitudes, Boulder City, Nevada



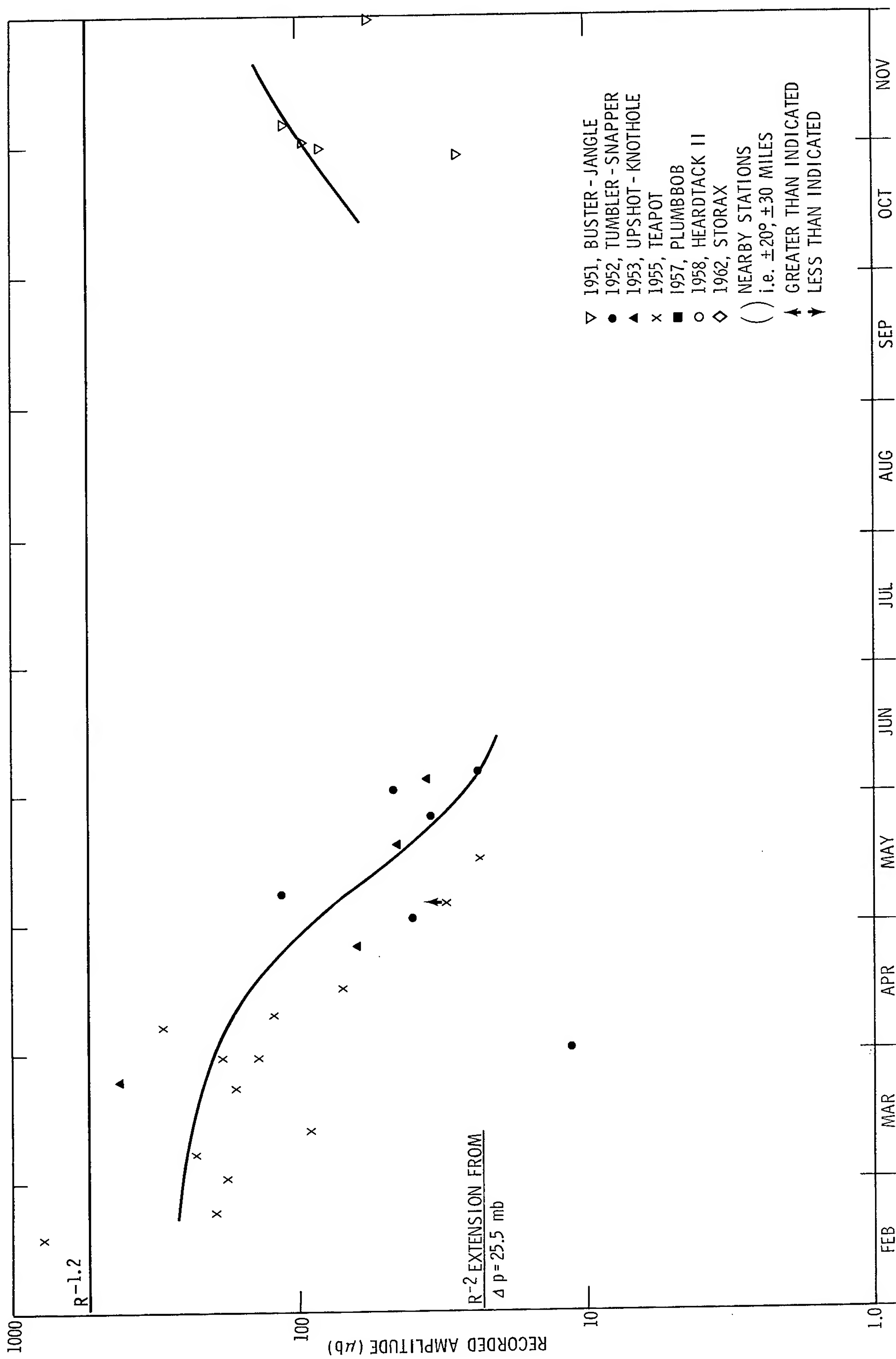


Figure 12. Ozonosphere Signal Amplitudes, Caliente, Nevada

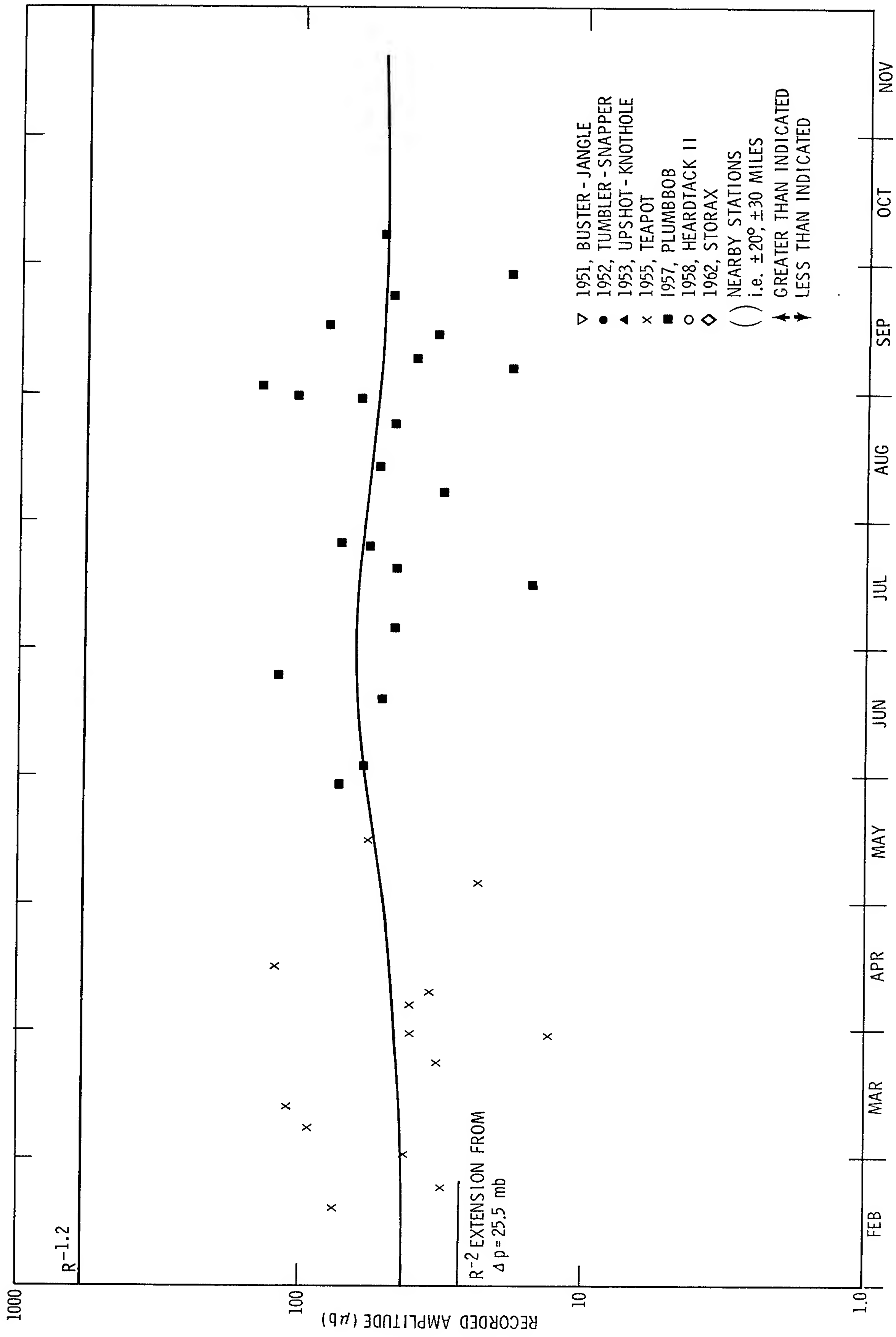


Figure 13. Ozonosphere Signal Amplitudes, Tonopah, Nevada

Five points from the shots with the very largest apparent yields have been identified to show that there seems to be no particular bias from yield-scaling assumptions. The standard amplitude for a 1-kiloton airburst, at 135 miles range, is shown, although specific shots were at individual distances which may be a few miles different. Also, these reference lines on this and successive figures were not adjusted for local pressure altitude. This correction gives a reduction to the standard curve which ranges from 3.6 percent for Las Vegas to 10.9 percent for Lund.

TABLE I  
Microbarograph Station Location Vectors\*

| Station                | Bearing<br>(Deg.) | Distance |          |
|------------------------|-------------------|----------|----------|
|                        |                   | Miles    | Kilofeet |
| Indian Springs, Nevada | 142               | 39       | 207      |
| Boulder City, Nevada   | 139               | 102      | 536      |
| Caliente, Nevada       | 64                | 98       | 516      |
| St. George, Utah       | 90                | 135      | 714      |
| Lund, Nevada           | 25                | 136      | 717      |
| Tonopah, Nevada        | 317               | 90       | 479      |
| Bishop, California     | 278               | 131      | 692      |
| China Lake, California | 223               | 132      | 700      |
| Las Vegas, Nevada      | 142               | 80       | 424      |

\*Referenced to Area 7, Yucca Flat

There were no atmospheric nuclear tests in December or January, and few in February and November, so it is impossible to tell whether the winter peak has been missed at St. George. Ray calculations for strongest midwinter rocket winds show the strongest caustics landing at ranges short of St. George, so the annual curve at a fixed distance may well have a flat maximum as shown by these data.

In summer the St. George minimum was well above the value obtained by extrapolating along  $p_k^* \sim R^{-2}$  and using a source point at  $\Delta p = 400$  mb. These ozonosphere-scattered waves were stronger than waves which were propagated along the ground under gradient conditions, although the latter were frequently detectable above ambient wind noise levels.

It is clear that an average of downwind propagations is about equal to the standard amplitude curve. This appears to contradict previous contentions that the average focus factor for ozonosphere signals was near 2X. Recall, however, that the standard here assumes doubling by ground reflection to give recorded amplitude; whereas, previous comparisons had reference to incident amplitude extrapolations, in keeping with convention for close-in blast measurements. In summary, at St. George one would expect 4 mb recorded amplitudes during the winter phase from 400 kilotons free airburst. This amplitude could come, however, with random focusing from only 32 kilotons FAB, or even 6.3 kiloton burst near 1650 feet HOB.

In the opposite direction toward Bishop, California, the same general pattern was observed, as shown by Figure 7, but with a 6-month phase change. The one extremely high point was actually observed at Deep Springs, about 20 miles east of Bishop, from the Small Boy event in 1962. This amplitude was reduced to correspond to the larger distance at Bishop. The focus factor for this wave was 3.2X.

Propagations in directions quartering to the winds, shown for Lund, Nevada, in Figure 8, are nearly the opposite direction of those for China Lake, California (Figure 9). Both appear to have downwind season averages near standard and similar to the results at St. George and Bishop, which were directly downwind of seasonal mean wind circulations. Lund and China Lake also show a tendency to have larger minimum amplitudes in their upwind seasons, as might be expected for scattered propagations. This filling of the minimum is more pronounced at Lund, bearing  $N25^{\circ}E$ , than at China Lake, bearing  $S45^{\circ}W$ , which is further consistent with the scattering model.

At shorter distances, the southeast line through Las Vegas and Boulder City shows lower amplitudes. At Las Vegas, range 80 miles, there is only slight indication of a seasonal wind influence in phase with ozonosphere cycling (Figure 10). The weak maximum in spring is its only manifestation. As shown in Figure 11, there is more of an annual wave at Boulder City, range 105 miles, but it is not nearly so pronounced as at longer ranges (135 miles) at the four stations described earlier. Boulder City clearly appears to be inside the range of maximum signals. In midwinter months of December and January, they could, however, get larger signals.

Caliente data taken at about 95 miles average range (Figure 12) show stronger amplitudes in winter than do those for Boulder City. Data are sparse for Caliente, but if the appearance is real it may be explained by the observation that very strong winter ozonosphere circulation causes the downwind caustic to land at short range, sometimes

as close as Caliente. The quartering cross-wind component was apparently not strong enough to pull the caustic in to the range of Boulder City during the months of testing.

Finally, Tonopah data in Figure 13 show a pattern similar to Las Vegas, with little apparent seasonal cycling, but slightly larger average amplitudes and some more scatter.

A check was made to see if yield-scaling factor corrections for the observed distance decay<sup>7</sup> reduced the scatter at St. George. It did not noticeably affect the variability. Thus, the more complicated calculation does not appear to improve predictability.

Upwind propagation between Caliente and St. George, and between Las Vegas and Boulder City, appears to decay like  $R^{-2}$ , but the coefficients depend on direction across the wind field. China Lake seems to be an exception to the upwind directional effect. Since these upwind waves are of such little importance to damage prediction, this inconsistency will be ignored and an approximate rule of thumb may be used: Recorded upwind ozonosphere signal amplitudes obtain from an extension from the end of IBM Problem M ( $\Delta p$  is multiplied by 2.7 to give recorded amplitude) with  $R^{-2}$  slope. This value is shown on all ozonosphere amplitude figures, and in equation form as

$$\text{Upwind Ozonosphere: } \overline{p_k^*} \text{ mb} \approx 6200 (\text{W kiloton NE})^{0.4} (R \text{ kilofeet})^{-2} \quad (5)$$

One point of interest noted is that the maxima in summer appear to lag two or three weeks behind the summer solstice, conforming with the surface temperature.

The freehand mean curves of Figures 6 through 13 have been assembled in Figure 14, which shows the transition season intersections which correspond to the no-wind condition. No confident explanation is made for the fact that amplitudes are smaller in the fall transition than during the spring reversal. It probably results from higher surface temperatures in late September than in early May, which would tend to reduce the amount of energy reflected back to ground level. It may be only a statistical observation from the small data sample and, in fact, this must be assumed for the present.

This transition period is of considerable importance because it is the time when maximum yields may be detonated without damage at long range in any direction. The distributions of data points from Figures 6 through 9 (nearly equal ranges at 135 miles) have been examined to find out how long an interval may be expected to be suitable for large yield experiments. Figure 15 shows distributions of amplitudes for  $\pm 5$  days and  $\pm 20$  days around May 5 and September 20 dates. As this interval is enlarged, scatter is increased to contain more points of both summer and winter propagation regimes.

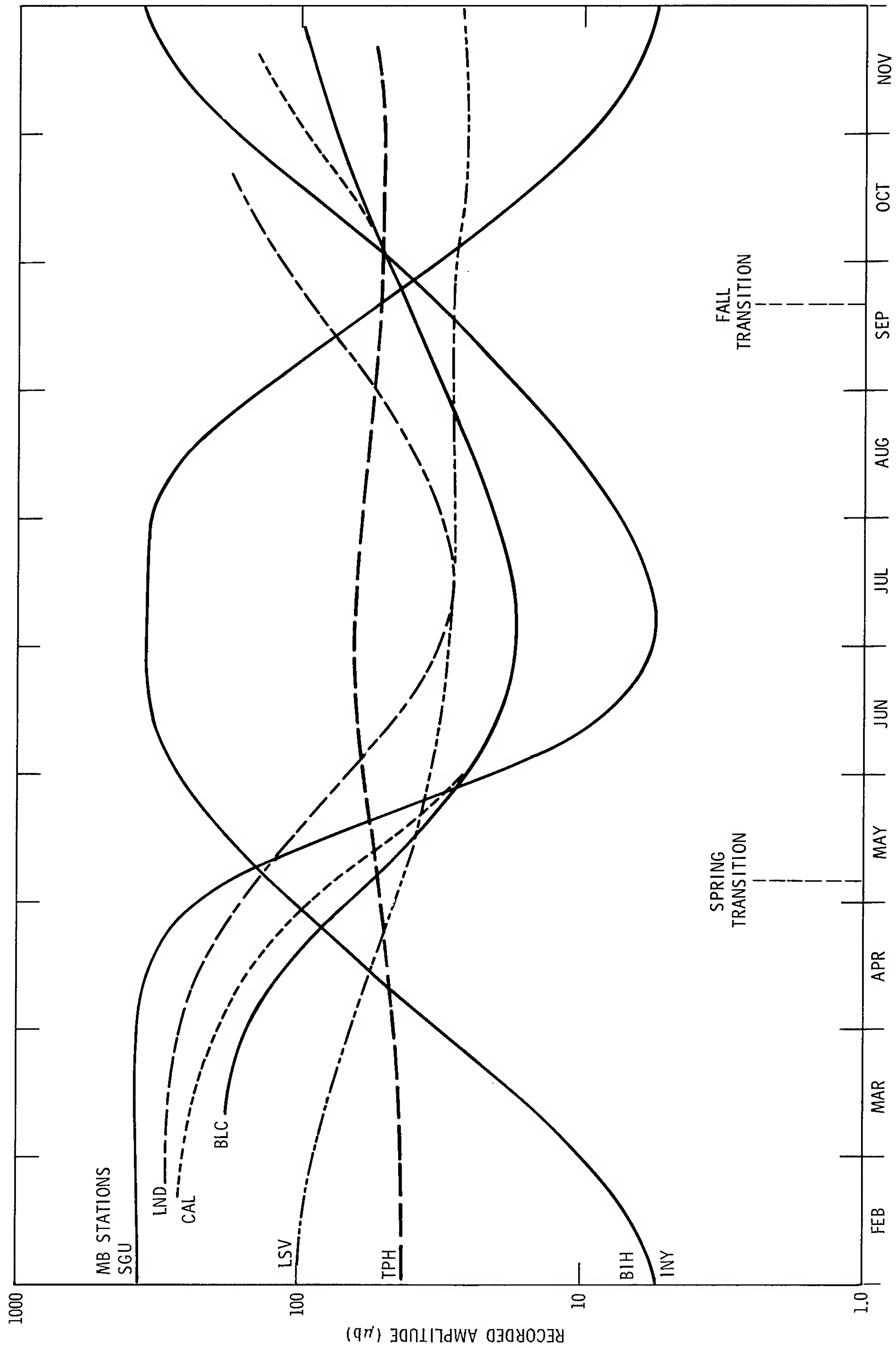


Figure 14. Average Ozonosphere Signal Amplitudes, Seasonal Cycling

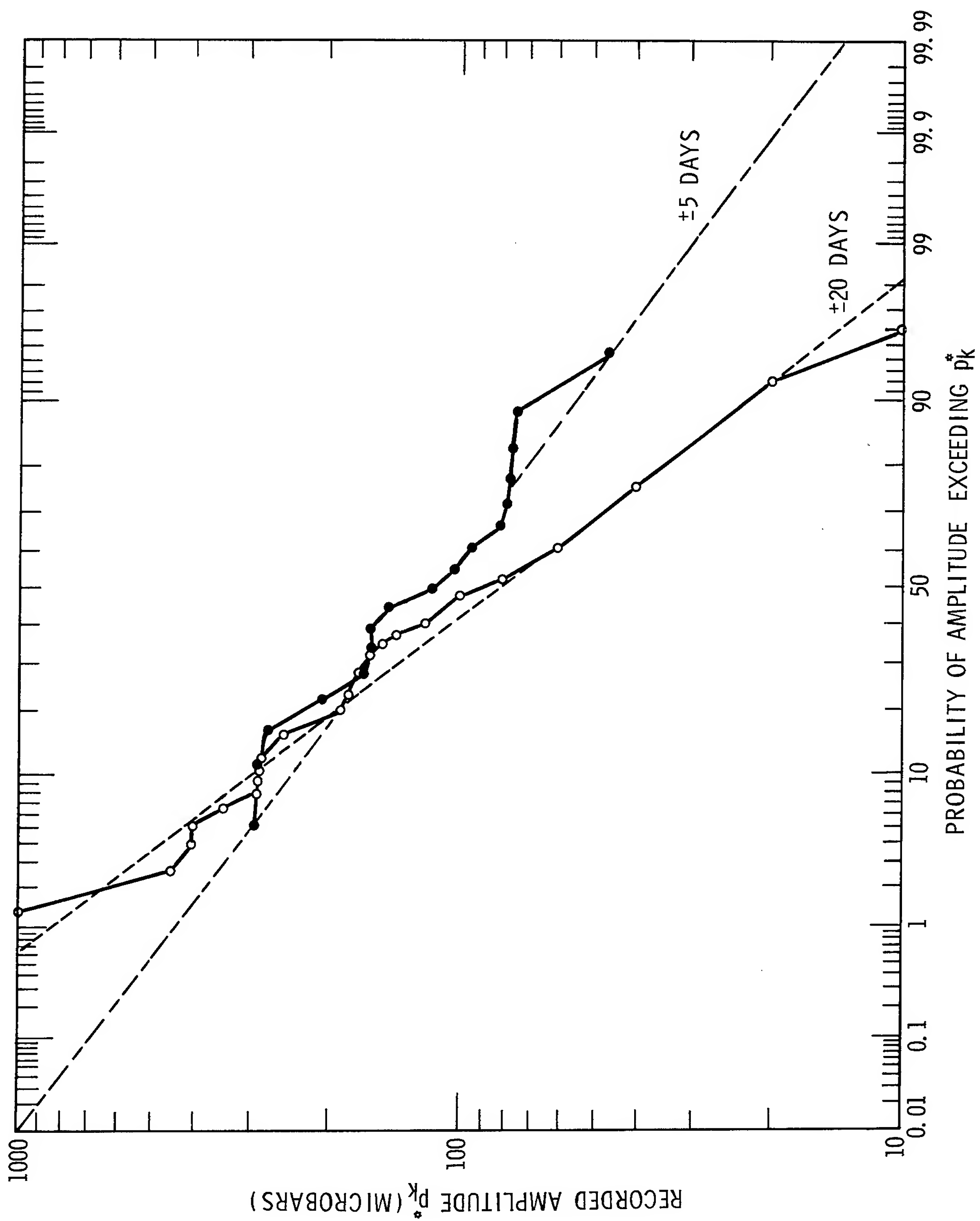


Figure 15. Distribution of Amplitudes in Transition Periods,  $R = 135$  mi.,  $W = 1$  kt NE F.A.B.



The average amplitude during these wind transitions is near 0.1 mb at 135 miles, and it is larger than recorded amplitudes at shorter ranges. This hump on the pressure-distance curve indicates that there is a tendency for a sound ring to occur even when the ozonosphere is calm. Even scattered or diffracted waves tend to strike the 135-mile range and skip the shorter ranges.

#### Calibration Shot Data

There is some concern that data obtained from 1.2-ton HE check shots or calibration shots may bias our interpretations of propagations from underground bursts. Figures 16 and 17 show amplitude versus date plots of some of these data from recordings made at St. George. Check shots were used 1 and 2 hours prior to atmospheric nuclear tests and were fired on the ground surface. Each was made up of four 600-pound depth charges, surplus from World War II. The equivalent yield for HE surface bursts is assumed to be 0.6 W; thus,  $W_A = 1.44 \times 10^{-3}$  kilotons NE FAB, and the "standard" line in Figure 16 reflects this assumption. Later, explosives were mounted at 15 feet above ground to enhance the apparent yield, give better repeatability, and minimize cratering. These calibration shots are assumed to yield  $W_A = 5.04 \times 10^{-3}$  kilotons NE FAB, to give the standard line in Figure 17. Note the changed date scale in Figure 17, used to accommodate the December and January ozonosphere data which have been accumulated in more recent years.

From these figures it is not clear that these waves suffered any significant average attenuation because of their higher frequency. A calculated downwind season average would probably give less than standard amplitude, but with the large scatter the probable error in the mean would also be relatively large. A further point is that the microbarograph recorders have a nonlinear attenuator set to damp high-frequency, low-amplitude signals so that many of the small reported data points may have really been over-attenuated.

#### Distributions of Downwind Ozonosphere Amplitudes

Recordings at St. George, made during the downwind months of November through March and analyzed in terms of focus factor statistics, are shown in Figure 18. Freehand



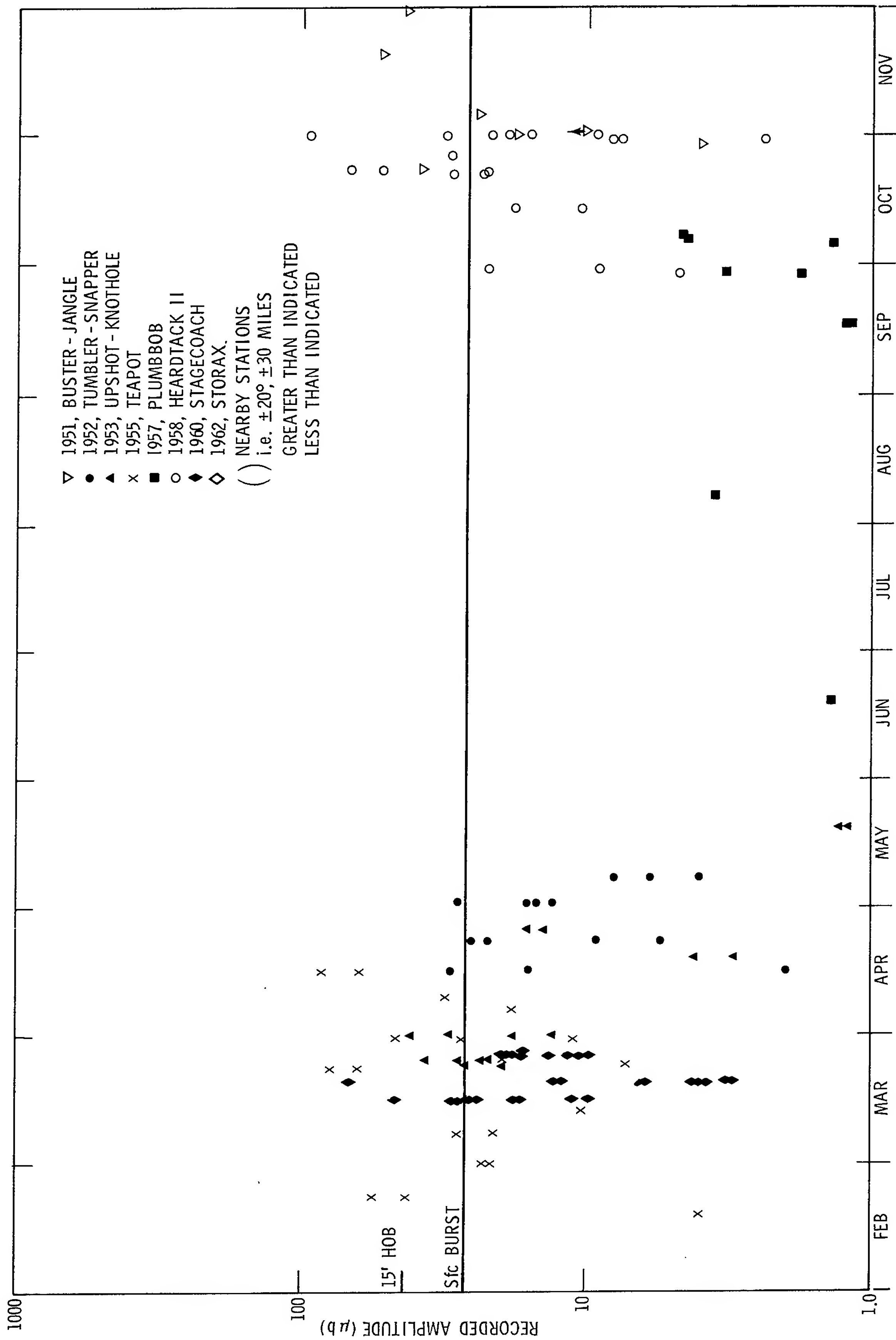


Figure 16. Check Shot Amplitudes, Ozonosphere Signals, St. George, Utah, for 1.2-ton HE Surface Bursts (Before 1960)

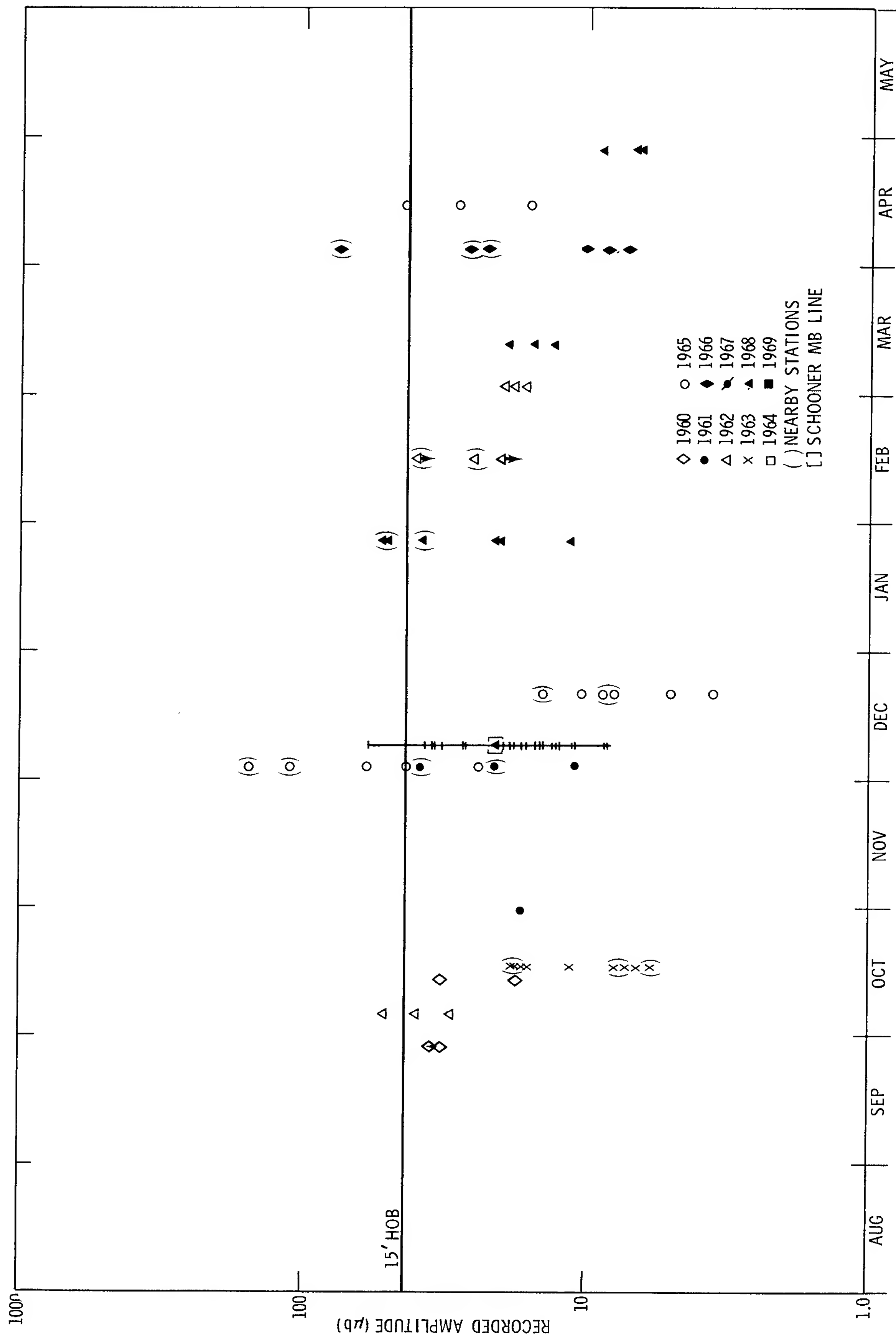


Figure 17. Check Shot Amplitudes, Ozonosphere Signals, St. George, Utah, for 1.2-ton HE at 15-Ft. HOB (1960 to Present)

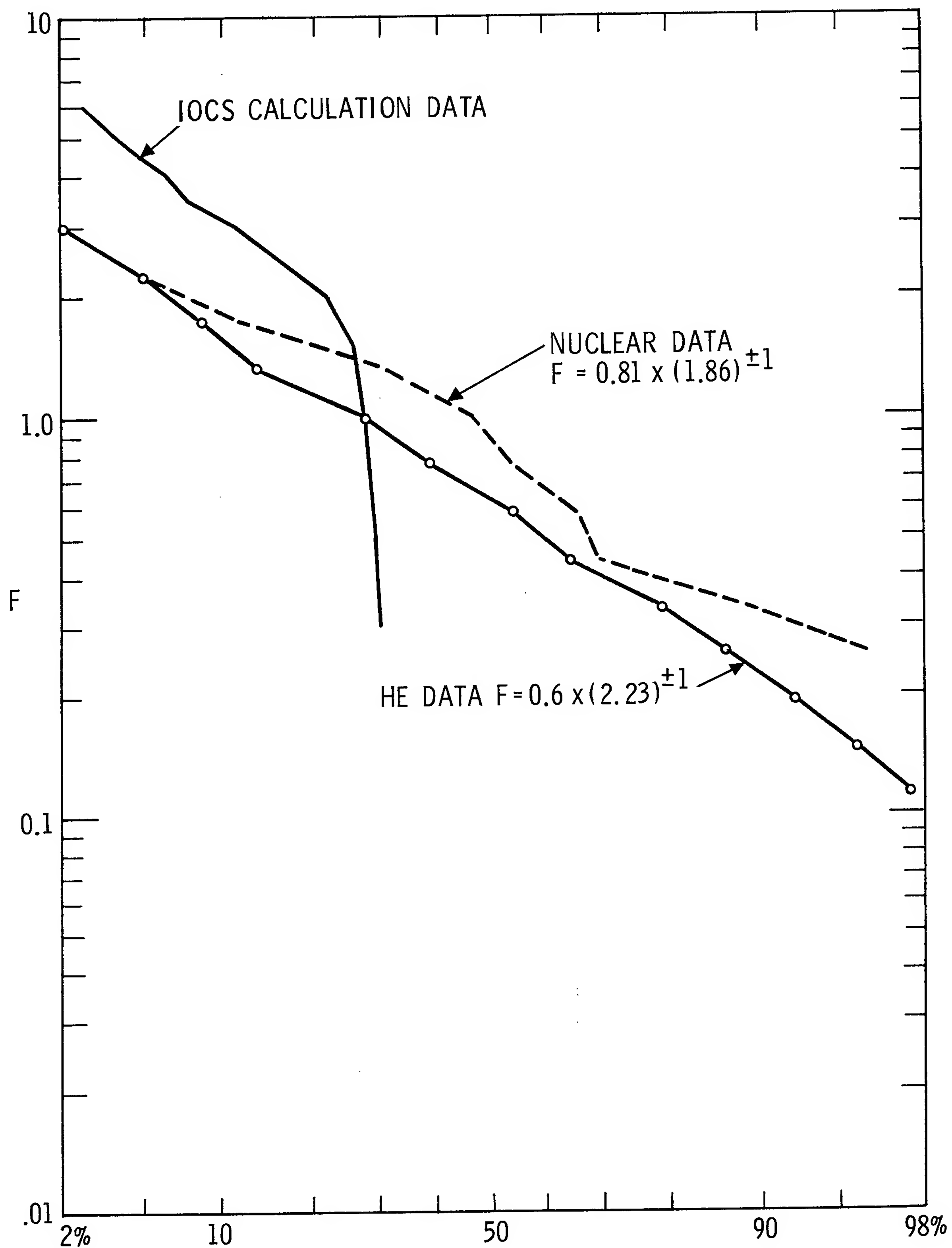


Figure 18. Distribution of Atmospheric Focus Factors, St. George, Utah, Winter Data (November - March)

curves of the separate distributions for NE and HE data give log-normal distribution functions

$$\begin{aligned}\text{NE: } F &= 0.81 \times (1.86)^{\pm 1} , \\ \text{HE: } F &= 0.6 \times (2.23)^{\pm 1} .\end{aligned}$$

The distribution midpoint for HE data is at  $F < 1.0$ , but it seems premature to adopt this without more detailed case studies. The Prairie Flat experiment<sup>8</sup> showed that, on the average, there was no significant difference between the attenuations of the 1.2-ton HE calibration shots and the 500-ton HE surface burst.

At any rate, the nuclear data show  $F = 1$  very near the 50 percent line, particularly when the distribution for the data-half with large amplitudes is extended. Most important is the appearance of less scatter to the nuclear data, although the reduction of scatter is not as marked as that found by comparison of different yields of HE at Prairie Flat.

A comparison with a distribution of calculated focus factors is also shown. Ray trace calculations for 415 rocket soundings at Battery MacKenzie, Canal Zone, were used for a source of focus factors at  $R = 700,000$  feet on days when some ducting was calculated. Of these, the calculated rays landed short of 700,000 feet on 275 occasions and long on 17 occasions, and a wave was found to strike this range on 123 occasions. The distribution of calculated  $F$  values is shown on Figure 18. Quite clearly, the real atmosphere attenuates the strong foci and fills the calculated silent zones with waves. There may be a significant difference between downwind propagations from NTS and from Panama, but it should depend only on the mere presence of adequate wind aloft speeds to cause ducting. There is almost twice as much energy flux calculated by numerical integration of  $F^2 dP$ , where  $P$  is probability, as was observed by the NTS distribution. The most likely repository for this excess of calculated ducted energy is in the multiplicity of wave cycles recorded by microbarographs. The acoustic ray calculation often shows only one wave cycle and sometimes two, rarely three or more. In reality, as described in the Prairie Flat analysis,<sup>8</sup> the upper wind structure has many reflecting layers which are not observable by present rocket sounding techniques. These strata tend to break up the wave into more fronts which spread over the sound ring and extend its boundaries. The result gives the observed attenuation, similar to the effect of turbulence. Most significantly, it reduces the expectation of very large amplitudes and strong foci which result from simple acoustic ray calculation, but for the present it makes deterministic prediction for a specific event much more uncertain.

## Tropospheric Propagation Climatology

Since experience with strong tropospheric ducting has been truncated by our attempts to prevent damage to outlying communities, it may be questioned that we call this observed collection of nuclear blast amplitudes a climatology. On the other hand, since the dominant concern was with jet-stream ducting, low altitude ducting under temperature and wind shear inversions was largely neglected so these results may be typical. This only affected on-site damages or, at worst, damages to the "controlled" population at Indian Springs. Since it may sometimes be useful in predicting inversion propagations, the amplitude distribution at Indian Springs is shown in Figure 19. Reference back to Figures 2 through 5 shows that large amplitudes on-site were common, but after travel over the mountains to Indian Springs the average focus factor had dropped from above 1 to near 1/2. Scatter was great, however, with  $\pm 1\sigma$  ranging from near 0.1 to 2.0 mb.

No attempt has been made to analyze on-site data distributions because the short distances would require a distance normalization calculation in addition to the yield normalization.

## Conclusions

There are three atmospheric sound ducts for significant airblast propagation off-site from NTS explosive tests. Strong propagation under inversions is usually restricted to the test basins of Yucca Flat or Frenchman's Flat by the surrounding mountains. These amplitudes decay rapidly with distance to off-site communities.

Strong winds in the troposphere can duct strong waves off-site and cause damages at Indian Springs and Las Vegas. Jet-stream ducting has given as much as 5X magnification in recorded nuclear blast waves, referenced to standard propagation in a homogeneous, calm atmosphere with spherical wave expansion and no refraction.

Ozonosphere ducting, from altitudes near 150,000 feet MSL, goes in seasonal directions: east in winter, west in summer. Maximum amplitudes usually strike at ranges near 135 miles but they may scatter from 75 miles to 150 miles. Maximum observed focusing from nuclear events is near 3X, and average downwind amplitudes fall near the standard curve. Upwind propagations are scattered into areas where there are no calculated acoustic ray penetrations, and amplitudes at 135 miles show an average 0.016X reduction below standard. During the short semi-annual periods of near-calm conditions

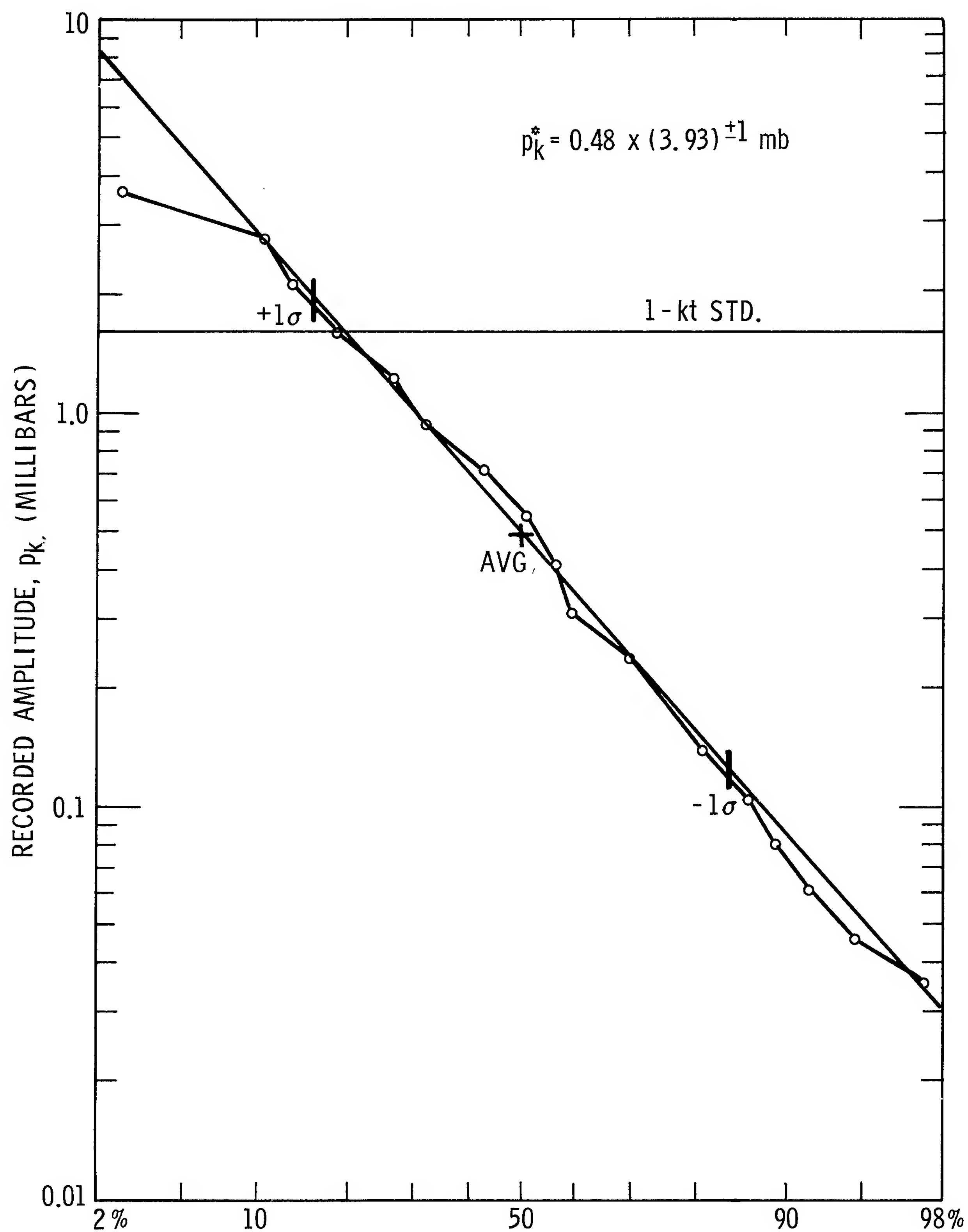


Figure 19. Troposphere Signals Scaled to 1-kt Free-Airburst Recorded Peak-to-Peak Amplitudes, Indian Springs (38 Miles)

at high altitudes, the average reduction is 0.28X in all directions. This occurs as seasonal wind directions reverse in early May and late September, but may happen early or late by as much as a month in a specific year.

Check shots and calibration shots, 1.2-ton HE bursts, give nearly the same amplitude propagation patterns as nuclear bursts and they do not appear to be specially attenuated because of their higher frequency components. Waves from these small yields have more scatter and non-repeatability in amplitude because their higher frequencies interact more with atmospheric turbulence and small-scale layer structures.

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## APPENDIX

### MAXIMUM SIGNAL AMPLITUDES FROM MICROBAROGRAPH RECORDS OF ATMOSPHERIC NUCLEAR TESTS

## APPENDIX

### MAXIMUM SIGNAL AMPLITUDES FROM MICROBAROGRAPH RECORDS OF ATMOSPHERIC NUCLEAR TESTS

The following tables show, for each Nevada nuclear test in Operation Tumbler-Snapper through Operation Hardtack-II, maximum peak-to-peak recorded airblast amplitudes which were propagated to each microbarograph via each of the three major atmospheric channels. The quality of these data generally improved with time as we developed our predictive and measuring capabilities. There are inconsistencies which may have resulted from any of several factors. Original records were not re-read at this time in hope of finding corrections. Past efforts to check specific questionable points have usually shown them to be impossible to adjust because of partial failures either by the equipment or the operators. Hopefully, in this large sample of data, the overall effect of these wild points is negligible.

For example, in the first table, for Tumbler-Snapper Event No. 1, the two sensors at St. George, C (close) and F (far), show a factor of four difference in amplitude for both troposphere and ozonosphere signals. On the check shots, however, there was not this disagreement, so it does not appear that set calibration was in error. Instead, it is likely that the operator failed to make the correct range switch setting or there was faulty wiring on one set for the full-scale test recording, but there is no way to establish which set was correct. Check shot amplitudes could be projected for calculations about which was correct but this would assume near-constant atmosphere propagation for 1 or 2 hours. That assumption could also be subject to considerable error.

Distance figures are also subject to some error, but they are probably not significant in this context. Some early station survey data were classified at their issuance and have since been destroyed. Only approximate locations were kept. This should seldom cause even a 1-mile error. Very accurate surveys (to  $\pm 0.1$  foot) were made for many stations during 1954, for sound-ranging calculations, so that distances are available to much greater precision than these tables show.

There has been no attempt to be consistent with significant figures in reporting amplitudes. Depending on ambient or electrical noise levels, calibration procedures, etc., original data tabulations reflected varying confidence, so one-, two- and three-significant figures are used indiscriminantly.

## MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Able DATE 10/22 /51 TIME 1400 Z

YIELD <0.1 kt    BURST HEIGHT 100 ft.    LOCATION A-3

APPARENT BLAST YIELD,  $W_a = >0.238$  kt,  $W_a^{0.4} >0.562$

[illegible]

(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Baker DATE 10/28/51 TIME 1520 Z  
 YIELD 3.5 kt BURST HEIGHT 1118 ft. LOCATION A-3  
 APPARENT BLAST YIELD,  $W_a = 16.9$  kt,  $W_a^{0.4} = 3.09$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Indian Springs | 150               | 197            | 520   |                  |                 |
| Las Vegas      | 141               | 405            | 9.5   | 134              |                 |
| Henderson      | 139               | 464            | 5.5   | >180             |                 |
| Boulder City   | 138               | 523            |   | 415              |                 |
| Caliente       | 065               | 481            | 15.5  | 85               |                 |
| St. George     | 089               | 713            |   | 345              |                 |
| Beatty         | 257               | 220            | 65  |                  |                 |
| Goldfield      | 304               | 424            | 930   |                  |                 |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Charlie DATE 10/30/51 TIME 1500 Z  
 YIELD 14.0 kt BURST HEIGHT 1132 ft. LOCATION A-3  
 APPARENT BLAST YIELD,  $W_a = 48.0$  kt,  $W_a^{0.4} = 4.71$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Indian Springs | 150               | 197            | 850   |                  |                 |
| Las Vegas      | 141               | 405            | 4.4   | 134              |                 |
| Henderson      | 139               | 464            |   | 330              |                 |
| Boulder City   | 138               | 523            |   | >340             |                 |
| Caliente       | 065               | 481            | 37  | 390              |                 |
| St. George     | 089               | 713            |   | 840              |                 |
| Beatty         | 257               | 220            | >630  |                  |                 |
| Goldfield      | 304               | 424            | 310   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Dog DATE 11/ 1 /51 TIME 1530 Z  
 YIELD 21 kt BURST HEIGHT 1417 ft. LOCATION A-3  
 APPARENT BLAST YIELD ,  $W_a = 77.4$  kt,  $W_a^{0.4} 5.69$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Indian Springs | 150               | 197            | >770  |                  |                 |
| Las Vegas      | 141               | 405            | >1080 (2)   |                  |                 |
| Henderson      | 139               | 464            | >910  |                  |                 |
| Boulder City   | 138               | 523            | >1040   |                  |                 |
| Caliente       | 065               | 481            | 470   | 545              |                 |
| St. George     | 089               | 713            | 705   | >1200            |                 |
| Beatty         | 257               | 220            | 295   |                  |                 |
| Goldfield      | 304               | 424            | (1)   | (1)              |                 |
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(1) No signal/noise.

(2) U. S. Weather Bureau, McCarran Field, barograph showed 2.4 MB amplitude but this equipment is heavily damped.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Easy DATE 11/5/51 TIME 1630 Z

YIELD 31.4 kt BURST HEIGHT 1314 ft. LOCATION A-3

APPARENT BLAST YIELD,  $W_a =$  \_\_\_\_\_ kt,  $W_a^{0.4}$  \_\_\_\_\_

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Indian Springs | 150               | 197            | >800  |                  |                 |
| Las Vegas      | 141               | 405            | >770  |                  |                 |
| Henderson      | 139               | 464            | >900  |                  |                 |
| Boulder City   | 138               | 523            | 225   |                  |                 |
| Caliente       | 065               | 481            | >900  | 710              |                 |
| St. George     | 089               | 713            | 175   | >295             |                 |
| Beatty         | 257               | 220            | >400  |                  |                 |
| Goldfield      | 304               | 424            | 950   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Sugar DATE 11/19/51 TIME 1700 Z

YIELD 1.2 kt BURST HEIGHT 4 ft. LOCATION A-10

APPARENT BLAST YIELD,  $W_a = 1.92$  kt,  $W_a^{0.4} = 1.298$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Indian Springs | 153               | 232            | 53  |                  |                 |
| Las Vegas      | 144               | 438            |   | 25               |                 |
| Henderson      | 141               | 496            |   | 93               |                 |
| Boulder City   | 140               | 555            |   | 130              |                 |
| Caliente       | 070               | 472            | 625   |                  |                 |
| St. George     | 092               | 718            | 163   | 152              |                 |
| Beatty         | 247               | 225            | >82   |                  |                 |
| Goldfield      | 300               | 399            | (1)   | (1)              |                 |
|                |                   |                |   |                  |                 |
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(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Uncle DATE 11/29/51 TIME 2000 Z  
 YIELD 1.2 kt BURST HEIGHT -17 ft. LOCATION A-10  
 APPARENT BLAST YIELD,  $W_a = 1.92$  (est'd) kt,  $W_a^{0.4} = 1.298$  (est'd)

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Indian Springs | 153               | 232            | 130   |                  |                 |
| Las Vegas      | 144               | 438            | 29.5  | 15.4             |                 |
| Henderson      | 141               | 496            | 40  | 130              |                 |
| Boulder City   | 140               | 555            | 4.2   | 102              |                 |
| Caliente       | 070               | 472            | 142   | 71               |                 |
| St. George     | 092               | 718            | 102   | 610              |                 |
| Beatty         | 247               | 225            | 25.5  |                  |                 |
| Goldfield      | 300               | 399            |   | 33               |                 |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-1 DATE 4/1/52 TIME 1700 Z

YIELD 1.1 kt BURST HEIGHT 793 ft. LOCATION FF

APPARENT BLAST YIELD,  $W_a = 5.45$  kt,  $W_a^{0.4} = 1.97$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas C   | 137               | 332            | 280   |                  |                 |
| Las Vegas F   | 137               | 336            | 300   |                  |                 |
| Henderson     | 134               | 399            | 65  |                  |                 |
| Boulder City  | 134               | 445            | 85  |                  |                 |
| Caliente      | 055               | 507            |   | 21               |                 |
| St. George C  | 082               | 692            | 50  | 98               |                 |
| St. George F  | 082               | 696            | 210   | 440 (1)          |                 |
| Goldfield     | 310               | 472            |   | 4                |                 |
|               |                   |                |   |                  |                 |
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(1) Discrepancy between sensors was not significant on check shots;  
suspect one range setting was made incorrectly.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-2 DATE 4 /15 /52 TIME 1730 Z

YIELD 1.2 kt BURST HEIGHT 1109 ft. LOCATION A-3

APPARENT BLAST YIELD ,  $W_a = 5.55$  kt,  $W_a^{0.4} 1.99$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas     | 141               | 404            | 31  | 47               |                 |
| Henderson     | 139               | 464            | 74  |                  |                 |
| Boulder City  | 138               | 523            |   | 105              |                 |
| St. George C  | 089               | 712            |   | 250              |                 |
| St. George F  | 089               | 716            |   | 420              |                 |
| Albuquerque   | 110               | 2920           |   | (1)              |                 |
|               |                   |                |   |                  |                 |
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(1) Loud bang distinctly heard by many residents, no MB recording.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-3 DATE 4/22 /52 TIME 1730 Z

YIELD 30.7 kt BURST HEIGHT 3447 ft. LOCATION A-3

APPARENT BLAST YIELD ,  $W_a = 133$  kt,  $W_a^{0.4} = 7.07$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas      | 141               | 404            | 740 (1)   | 120              |                 |
| Henderson      | 139               | 464            | 800   | 160              |                 |
| Boulder City C | 138               | 523            | 520   | 180              |                 |
| Boulder City F | 138               | 528            | 600   | 220              |                 |
| Caliente       | 065               | 481            | 480   |                  |                 |
| St. George     | 089               | 713            |   | 230              |                 |
| Goldfield      | 304               | 424            | 1005 (1)  |                  |                 |
|                |                   |                |   |                  |                 |
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(1) Some confusion on timing; these signals were originally recorded as ozonosphere propagations.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-4 DATE 5/1 /52 TIME 1630 Z  
 YIELD 19.2 kt BURST HEIGHT 1040 ft. LOCATION A-3  
 APPARENT BLAST YIELD,  $W_a = 57.2$  kt,  $W_a^{0.4} 5.04$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas      | 141               | 404            | 305   | 180              |                 |
| Henderson      | 139               | 464            | 210   |                  |                 |
| Boulder City C | 138               | 523            | 100   | 110              |                 |
| Boulder City F | 138               | 528            | 180   | 210 (2)          |                 |
| Caliente       | 065               | 481            | 230   | 205              |                 |
| St. George C   | 089               | 712            | 100   | 115              |                 |
| St. George F   | 089               | 716            | 103   | 800 (1)          |                 |
| Goldfield      | 304               | 424            | 280   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
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|                |                   |                |   |                  |                 |

- (1) Very doubtful report.  
 (2) Suspect one set out of calibration.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-5 DATE 5 / 7 / 52 TIME 1215 Z

YIELD 12.0 kt BURST HEIGHT 300 ft. LOCATION T-1

APPARENT BLAST YIELD ,  $W_a = 24.2$  kt,  $W_a^{0.4} 3.58$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas C    | 141               | 435            |   | 190              |                 |
| Las Vegas F    | 141               | 440            |   | 210              |                 |
| Boulder City C | 137               | 539            |   | 210              |                 |
| Boulder City F | 137               | 547            |   | 240              |                 |
| Caliente       | 067               | 505            | > 950   | 410              |                 |
| St. George C   | 090               | 730            | 650   |                  |                 |
| St. George F   | 090               | 733            | 560   |                  |                 |
| Goldfield      | 304               | 405            |   | 115              |                 |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-6 DATE 5 / 25 / 52 TIME 1200 Z

YIELD 11.1 kt BURST HEIGHT 300 ft. LOCATION T-4

APPARENT BLAST YIELD ,  $W_a = 22.5$  kt,  $W_a^{0.4} 3.48$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK - TO - PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas      | 142               | 447            |   | 130              |                 |
| Henderson      | 139               | 490            | 45  | 80               |                 |
| Boulder City C | 138               | 551            |   | 85               |                 |
| Boulder City F | 138               | 558            |   | 170              |                 |
| Caliente       | 068               | 498            |   | 120              |                 |
| St. George C   | 091               | 733            | 40  |                  | 47              |
| St. George F   | 091               | 737            | 45  |                  | 37              |
| Goldfield      | 306               | 393            | 140   |                  |                 |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-7 DATE 6 / 1 / 52 TIME 1155Z

YIELD 14.6 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD,  $W_a = 29.4$  kt,  $W_a^{0.4} = 3.86$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas      | 143               | 419            | 260   | 110              |                 |
| Henderson      | 139               | 464            | 52  | 90               |                 |
| Boulder City C | 139               | 522            |   | 100              |                 |
| Boulder City F | 139               | 529            |   | 180              |                 |
| Caliente       | 065               | 484            |   | 180              |                 |
| St. George C   | 089               | 709            |   | 55               | 110             |
| St. George F   | 089               | 714            |   | 60               | 140             |
| Goldfield      | 304               | 424            |   | 105              |                 |
| Los Angeles    | 212               | 1220           |   | (1)              |                 |
|                |                   |                |   |                  |                 |
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(1) Heard, record for Pasadena not available.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-8 DATE 6 / 5 / 52 TIME 1155 Z

YIELD 13.9 kt BURST HEIGHT 300 ft. LOCATION T-2

APPARENT BLAST YIELD ,  $W_a = 28.0$  kt,  $W_a^{0.4} = 3.79$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Las Vegas      | 143               | 462            |   | 110              |                 |
| Boulder City C | 139               | 565            |   | 140              |                 |
| Boulder City F | 139               | 572            |   | 160              |                 |
| Caliente       | 070               | 497            | 30  | 90               |                 |
| St. George C   | 092               | 737            |   | 13               | 44              |
| St. George F   | 092               | 741            |   | 20               | 100             |
| Goldfield      | 300               | 411            | 460   | 87               |                 |
| Los Angeles    | 212               | 1220           |   | 88               |                 |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Annie DATE 3 /17/53 TIME 1320 Z

YIELD 16.2 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD,  $W_a = 32.4$  kt,  $W_a^{0.4} = 4.02$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Mercury             | 177               | 141.5          | 5100  |                  |                 |
| Indian Springs<br>F | 152               | 193.2          | 3102  |                  |                 |
| Las Vegas C         | 137               | 411            | 360   |                  |                 |
| Las Vegas F         | 137               | 415            | 390   |                  |                 |
| St. George C        | 089               | 709            | 585   |                  |                 |
| St. George F        | 089               | 714            | 525   |                  |                 |
| Goldfield C         | 304               | 425            |   | 210              |                 |
| Pasadena            | 212               | 1221           |   | 130              | 80              |
|                     |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Nancy DATE 3/24/53 TIME 1310 Z

YIELD 24.4 kt BURST HEIGHT 300 ft. LOCATION T-4

APPARENT BLAST YIELD,  $W_a = 47.9$  kt,  $W_a^{0.4} = 4.70$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1                | 167               | 59.9           | 9600  |                  |                 |
| FFT                 | 167               | 109.0          | 1300  |                  |                 |
| Mercury             | 169               | 161.9          | 325   |                  |                 |
| Indian Springs<br>C | 149               | 216            | 280   |                  |                 |
| Las Vegas C         | 142               | 439            |   | 380              |                 |
| Las Vegas F         | 142               | 444            |   | 460              |                 |
| Boulder City        | 138               | 550.7          |   | 526              |                 |
| Caliente            | 068               | 498.4          |   | 2000             |                 |
| St. George C        | 091               | 732.7          |   | 2000             |                 |
| St. George F        | 091               | 737            |   | 1600             |                 |
| Cedar City C        | 077               | 906            | 120   | 1200             |                 |
| Cedar City F        | 077               | 911.6          | 120   | 1320             |                 |
| Goldfield C         | 304               | 394            | 55  | 100              |                 |
| Goldfield F         | 304               | 396            | 70  | 120              |                 |
| Albuquerque         | 110               | 2920           |   | 103              |                 |
| Pasadena            | 212               | 1229           |   | 56               | 90              |
|                     |                   |                |   |                  |                 |

# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Ruth DATE 3 /31 /53 TIME 1300 Z  
 YIELD 0.2 kt BURST HEIGHT 300 ft. LOCATION A-7.5  
 APPARENT BLAST YIELD ,  $W_a = 0.882$  kt,  $W_a^{0.4} = 0.73$

| MB STATION       | AZIMUTH (DEG.) | RANGE (KFT) | RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS) |              |             |
|------------------|----------------|-------------|--|--------------|-------------|
|                  |                |             | TROPO-SPHERE   | OZONO-SPHERE | IONO-SPHERE |
| CP-1             | 191            | 54.7        | 8400   |              |             |
| XMF-1            | 185            | 68.9        | 4500   |              |             |
| XMF-2            | 185            | 68.9        | 4500   |              |             |
| FFT              | 179            | 101.8       | 3200   |              |             |
| SCU              | 178            | 133         | 3900   |              |             |
| Mercury          | 177            | 154.9       | 2160   |              |             |
| Indian Springs C | 154            | 205.0       | 690  |              |             |
| Las Vegas C      | 144            | 429.0       | 132  |              |             |
| Las Vegas F      | 144            | 435         | 110  |              |             |
| Boulder City     | 140            | 531.7       | 22.6   |              |             |
| Caliente         | 067            | 477.7       | 123.0  |              |             |
| St. George C     | 090            | 708.6       | 20   | 220          |             |
| St. George F     | 090            | 712.4       |  | 260          |             |
| Cedar City C     | 076            | 884         | 7.8  | 97.2         |             |
| Cedar City F     | 076            | 889.2       |  | 84           |             |
| Goldfield C      | 304            | 417         |  | 10.2         |             |
| Albuquerque      | 110            | 2920        |  | 29.3         |             |
| Pasadena         | 212            | 1229        |  | 22.0         | 20.0        |

# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Dixie DATE 4 / 6 / 53 TIME 1530 Z  
 YIELD 10.9 kt BURST HEIGHT 6020 ft. LOCATION A-7.3  
 APPARENT BLAST YIELD,  $W_a = 10.9$  kt,  $W_a^{0.4} = 2.60$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1                | 191               | 55.5           | 10168   |                  |                 |
| XFM                 | 185               | 69.5           | 3970  |                  |                 |
| FFT                 | 179               | 101.8          | 3683  |                  |                 |
| SCU                 | 178               | 133            | 4078  |                  |                 |
| Mercury             | 177               | 154.9          | 2280  |                  |                 |
| HWY                 | 177               | 176            | 1880  |                  |                 |
| Indian Springs<br>C | 154               | 200.5          | > 3200  |                  |                 |
| Indian Springs<br>F | 154               | 205.0          | > 3200  |                  |                 |
| Las Vegas C         | 144               | 429.0          | > 2320  |                  |                 |
| Las Vegas F         | 144               | 425            | 2480  |                  |                 |
| Boulder City        | 140               | 531.7          | 2320  |                  |                 |
| Caliente            | 067               | 477.7          | > 878   |                  |                 |
| St. George C        | 090               | 708.6          | 1000  |                  |                 |
| St. George F        | 090               | 712.4          | 780   |                  |                 |
| Cedar City C        | 076               | 884            | 336   | 732              |                 |
| Cedar City F        | 076               | 889.2          | 312   | 636              |                 |
| Goldfield C         | 304               | 417            |   | 328              |                 |
| Goldfield F         | 304               | 421            |   | 400              |                 |
| Pasadena            | 212               | 1229           | 46.5  | 96.0             |                 |

# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Ray DATE 4 /11 /53 TIME 1245 Z  
 YIELD 0.2 kt BURST HEIGHT 100 ft. LOCATION T-4A  
 APPARENT BLAST YIELD,  $W_a = 0.424$  kt,  $W_a^{0.4} = 0.709$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1                | 167               | 55.9           | 5300  |                  |                 |
| XFM                 | 172               | 77.3           | 4800  |                  |                 |
| SCU                 | 165               | 142            | 3300  |                  |                 |
| Mercury             | 169               | 161.9          | 2080  |                  |                 |
| Indian Springs<br>C | 149               | 220.2          | 2663  |                  |                 |
| Indian Springs<br>F | 149               | 224.9          | 2250  |                  |                 |
| Las Vegas C         | 142               | 446.9          | 420   |                  |                 |
| Las Vegas F         | 142               | 452            | 476   |                  |                 |
| Henderson           | 140               | 524            | 620   |                  |                 |
| Boulder City        | 138               | 558            | 200   |                  |                 |
|                     |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Badger DATE 4/18/53 TIME 1235 Z  
 YIELD 23.0 kt BURST HEIGHT 300 ft. LOCATION T-2  
 APPARENT BLAST YIELD,  $W_a = 45.8$  kt,  $W_a^{0.4} = 4.61$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| XFM                 | 166               | 92.8           | 8160  |                  |                 |
| FFT                 | 166               | 125.2          | 6740  |                  |                 |
| SCU                 | 167               | 158.5          | 4500  |                  |                 |
| Mercury             | 168               | 178.1          | 2840  |                  |                 |
| HWY                 | 168               | 200.6          | 2400  |                  |                 |
| Indian Springs<br>C | 150               | 231.4          | 3570  |                  |                 |
| Indian Springs<br>F | 150               | 235.9          | 3400  |                  |                 |
| Las Vegas C         | 143               | 456            | 330   |                  |                 |
| Las Vegas F         | 143               | 461.9          | 360   |                  |                 |
| Boulder City        | 139               | 572.5          | 467   | 204              |                 |
| Caliente            | 070               | 496.7          | >960  |                  |                 |
| St. George C        | 092               | 737.0          | >960  | 540              |                 |
| St. George F        | 092               | 741            | >960  | 600              |                 |
| Cedar City C        | 078               | 908            | >320  | >320             | 72              |
| Cedar City F        | 078               | 911.9          | >320  | >320             | 168             |
| Goldfield C         | 304               | 378            | 30  | 255              | 36              |
| Goldfield F         | 304               | 382            |   | >215             |                 |
| Albuquerque         | 110               | 2920           | 8.1   | 18.9             |                 |
| Pasadena            | 212               | 1232           |   | 117.0            | 56.4            |



# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Simon DATE 4 /25 /53 TIME 1230 Z

YIELD 42.7 kt BURST HEIGHT 300 ft. LOCATION T-1

APPARENT BLAST YIELD ,  $W_a = 83.3$  kt,  $W_a^{0.4} 5.85$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| XMF                 | 163               | 61.4           | 11100   |                  |                 |
| FFT                 | 163               | 94.2           | 4760  |                  |                 |
| SCU                 | 165               | 125.2          | 3290  |                  |                 |
| Mercury             | 167               | 146.6          | 1960  |                  |                 |
| Indian Springs<br>C | 146               | 202.5          | > 900   |                  |                 |
| Indian Springs<br>F | 146               | 207.0          | > 780   |                  |                 |
| Las Vegas C         | 141               | 431            | 283   | 259              |                 |
| Las Vegas F         | 141               | 434.9          | 232   | 165              |                 |
| Boulder City        | 137               | 546.7          |   | 870              |                 |
| Caliente            | 067               | 504.5          | 585   | 362              |                 |
| St. George C        | 090               | 733.0          |   | 1000             |                 |
| Cedar City C        | 076               | 912            | 90  | 1440             | 180             |
| Cedar City F        | 076               | 915.6          | 94  | 1680             | 210             |
| Goldfield F         | 304               | 405            | 103.2   | 190              |                 |
| Beatty              | 254               | 191            | 408   |                  |                 |
| Albuquerque         | 110               | 2920           |   | 180              |                 |
| Pasadena            | 212               | 1210           | 10  | 150              |                 |

# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Encore DATE 5/8/53 TIME 1530 Z  
 YIELD 26.5 kt BURST HEIGHT 2425 ft. LOCATION FF  
 APPARENT BLAST YIELD,  $W_a = 133.8$  kt,  $W_a^{0.4} = 7.07$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1                | 323               | 61.7           | 8475  |                  |                 |
| Mercury             | 200               | 53.3           | 20600 (1)   |                  |                 |
| Indian Springs<br>C | 141               | 97.5           | 4300  |                  |                 |
| Indian Springs<br>F | 141               | 102.0          | 4460  |                  |                 |
| Las Vegas C         | 137               | 327            | 648   |                  |                 |
| Las Vegas F         | 137               | 331.6          | 600   |                  |                 |
| Las Vegas #3        | 137               | 335            | 675   |                  |                 |
| Boulder City        | 134               | 437.9          | 120   |                  |                 |
| Caliente            | 055               | 507.3          | 4320  |                  |                 |
| St. George C        | 082               | 691.7          | 2000  |                  |                 |
| St. George F        | 082               | 695.2          | 1930  |                  |                 |
| Cedar City C        | 069               | 893            | 1530  |                  |                 |
| Cedar City F        | 069               | 897.9          | 1640  |                  |                 |
| Goldfield C         | 312               | 497            |   | 480              |                 |
| Goldfield F         | 312               | 502            |   | 516              |                 |
| Bishop C            | 285               | 748.2          |   | 2046             |                 |
| Bishop F            | 285               | 752.8          |   | 1160             |                 |
| Albuquerque         | 110               | 2920           |   | (2)              |                 |
| Pasadena            | 215               | 1160           |   | 200              |                 |

(1) Broke small windows.

(2) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Harry DATE 5 /19 /53 TIME 1205 Z

YIELD 32.4 kt BURST HEIGHT 300 ft. LOCATION T-3A

APPARENT BLAST YIELD,  $W_a = 63.9$  kt,  $W_a^{0.4} = 5.26$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Mercury             | 176               | 139.0          | 2000  |                  |                 |
| Indian Springs<br>C | 151               | 187            | > 3200  |                  |                 |
| Indian Springs<br>F | 151               | 191.4          | 2464  |                  |                 |
| Las Vegas C         | 143               | 412            | 2380  | 186              |                 |
| Las Vegas F         | 143               | 417.1          | 2210  | 194              |                 |
| Boulder City        | 139               | 527.9          | 850   | 238              |                 |
| Caliente            | 065               | 486.1          | 310   | 240              |                 |
| St. George C        | 089               | 710.6          | 540   | 252              | 18              |
| St. George F        | 089               | 715            | 505   | 252              | 24              |
| Cedar City C        | 075               | 891            | 90  | 120              | 60              |
| Cedar City F        | 075               | 895.2          | 80  | 140              | 60              |
| Goldfield C         | 304               | 421            |   | 640              |                 |
| Goldfield F         | 304               | 425            |   | 720              |                 |
| Bishop C            | 279               | 700.3          |   | 1488             | 223             |
| Bishop F            | 279               | 705.0          |   | 1320             | 160             |
| Pasadena            | 212               | 1218           |   | 350              | 135             |
| Albuquerque         | 110               | 2890           | 6   | 24               |                 |

# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Grable DATE 5 /25 /53 TIME 1530 Z

YIELD 14.9 kt BURST HEIGHT 524 ft. LOCATION FF

APPARENT BLAST YIELD,  $W_a = 33.4$  kt,  $W_a^{0.4} = 4.07$

| MB<br>STATION       | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------------|-------------------|----------------|---|------------------|-----------------|
|                     |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1                | 324               | 61.7           | 14700   |                  |                 |
| Mercury             | 200               | 53.3           | 7440  |                  |                 |
| Groome Mine         | 020               | 203            | 15000   |                  |                 |
| Indian Springs<br>C | 141               | 97.5           | > 960   |                  |                 |
| Indian Springs<br>F | 141               | 102.0          | > 960   |                  |                 |
| Las Vegas C         | 137               | 327            | 123   | 336              |                 |
| Las Vegas F         | 137               | 331.6          | 112   | 269              |                 |
| Boulder City        | 134               | 437.9          | 36  | 168              |                 |
| Caliente            | 055               | 507.3          | 2760  |                  |                 |
| St. George C        | 082               | 691.7          | 1650  |                  |                 |
| St. George F        | 082               | 695.2          | 1800  |                  |                 |
| Cedar City C        | 069               | 893            | 1320  |                  |                 |
| Cedar City F        | 069               | 897.9          | 1160  |                  |                 |
| Goldfield C         | 312               | 497            | 1125  | 280              |                 |
| Goldfield F         | 312               | 502            | 920   | 260              |                 |
| Bishop C            | 285               | 748.2          |   | 1140             |                 |
| Bishop F            | 285               | 752.8          |   | 1590             |                 |
| Pasadena            | 215               | 1160           |   | 140              | 60              |
| Albuquerque         | 110               | 2920           |   | (1)              |                 |

(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Climax DATE 6 / 4 / 53 TIME 1115 Z  
 YIELD 60.8 kt BURST HEIGHT 1334 ft. LOCATION T-7-3  
 APPARENT BLAST YIELD ,  $W_a = 165.1$  kt,  $W_a^{0.4} = 7.70$

| MB STATION       | AZIMUTH (DEG.) | RANGE (KFT) | RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS) |              |             |
|------------------|----------------|-------------|--|--------------|-------------|
|                  |                |             | TROPO-SPHERE   | OZONO-SPHERE | IONO-SPHERE |
| CP-1             | 191            | 55.3        | 22800  |              |             |
| Mercury          | 177            | 154.9       | 3200   |              |             |
| Indian Springs C | 154            | 201         | 465  |              |             |
| Indian Springs F | 154            | 205.0       | 485  |              |             |
| Las Vegas C      | 144            | 424         |  | 180          |             |
| Las Vegas F      | 144            | 429.0       |  | 180          |             |
| Las Vegas #3     | 144            | 433         | 40   | 220          |             |
| Boulder City     | 140            | 539.0       |  | 390          |             |
| Caliente         | 067            | 477.7       | 180  | 280          |             |
| St. George C     | 090            | 708.6       |  | 160          | 170         |
| St. George F     | 090            | 713         |  | 140          | 180         |
| Cedar City C     | 076            | 885         |  | 110          | 140         |
| Cedar City F     | 076            | 889.2       |  | 100          | 120         |
| Goldfield C      | 304            | 421         | 120  | 300          |             |
| Goldfield F      | 304            | 425         | 120  | 240          |             |
| Bishop C         | 277            | 699.2       |  | 2040         |             |
| Bishop F         | 277            | 703.9       |  | 2460         |             |
| Pasadena         | 212            | 1218        |  | 300 (1)      |             |
| Albuquerque      | 110            | 2890        |  | 63.5         |             |

(1) Newspapers headline "Mysterious Blast Rocks LA."

# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Wasp DATE 2 /18 /55 TIME 2000 Z  
 YIELD 1.2 kt BURST HEIGHT 762 ft. LOCATION T-7-4  
 APPARENT BLAST YIELD,  $W_a =$  5.72 kt,  $W_a^{0.4}$  2.01

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 191               | 55.3           | 5040  |                  |                 |
| Mercury        | 177               | 155.2          | 2070  |                  |                 |
| Indian Springs | 154               | 205.4          | 2663  |                  |                 |
| Las Vegas      | 142               | 421.5          | 670   | 360              |                 |
| Boulder City   | 140               | 531.6          | 530   | 140              |                 |
| Caliente       | 067               | 478.7          |   | 1600             |                 |
| St. George     | 090               | 710.1          | 40  | 260              |                 |
| Cedar City     | 075               | 889            |   | 280              |                 |
| Lund           | 024               | 708            |   | 192              |                 |
| Tonopah        | 318               | 474.6          |   | 154              |                 |
| Bishop         | 278               | 700.2          |   | (1)              |                 |
| Inyokern       | 224               | 700.4          |   | (1)              |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |

(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Moth DATE 2 /22 /55 TIME 1345 Z

YIELD 2.4 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD,  $W_a = 5.45$  kt,  $W_a^{0.4} 1.97$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 194               | 41.8           | 14640   |                  |                 |
| Mercury        | 177               | 141.5          | 5800  |                  |                 |
| Indian Springs | 152               | 193.2          | 5544  |                  |                 |
| Las Vegas      | 143               | 418.6          | 2992  | 88               |                 |
| Boulder City   | 139               | 521.9          | 1121  | 162              |                 |
| Caliente       | 065               | 483.7          | 32  | 1088             |                 |
| St. George     | 089               | 709.3          | 232   | 1032             |                 |
| Cedar City     | 075               | 893.3          | 72.6  | 386              |                 |
| Lund           | 024               | 720.1          | 3.6   | 389              |                 |
| Tonopah        | 320               | 483.5          |   | 62.4             |                 |
| Bishop         | 279               | 701.1          |   | 4.2              | >96             |
| Inyokern       | 224               | 689.8          | 4.1   | 33.6             | 52.3            |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Tesla DATE 3 / 1 / 55 TIME 1330 Z  
 YIELD 6.8 kt BURST HEIGHT 300 ft. LOCATION T-9B  
 APPARENT BLAST YIELD ,  $W_a = 14.7$  kt,  $W_a^{0.4} = 2.93$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 182               | 69.3           | 11280   |                  |                 |
| Mercury        | 175               | 170.3          | 2088  |                  |                 |
| Indian Springs | 154               | 221.9          | > 2232  |                  |                 |
| Las Vegas      | 144               | 445.8          | > 311   | 164.8            | 14              |
| Boulder City   | 140               | 548.3          | 160   | 344              |                 |
| Caliente       | 069               | 479.4          | 348   | 524              |                 |
| St. George     | 092               | 716.5          | 329   | >> 960           |                 |
| Lund           | 025               | 702.4          | 126   | >> 888           |                 |
| Tonopah        | 318               | 457.0          | 21.0  | 126              |                 |
| Bishop         | 276               | 689.1          |   |                  | 51.0            |
| Inyokern       | 222               | 704.7          |   | 13.2             | 104.8           |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Turk DATE 3/7 /55 TIME 1320 Z

YIELD 43 kt BURST HEIGHT 500 ft. LOCATION T-2

APPARENT BLAST YIELD,  $W_a =$                       kt,  $W_a^{0.4}$                      

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 166               | 76.2           | >14880 (1)  |                  |                 |
| Mercury        | 168               | 178.1          | 1760  |                  |                 |
| Indian Springs | 150               | 235.9          | 416   |                  |                 |
| Las Vegas      | 143               | 461.9          | 54.0  | 480              |                 |
| Boulder City   | 139               | 565.3          | 48  | 454              |                 |
| Caliente       | 070               | 496.7          | 240   | 1410             |                 |
| St. George     | 092               | 737.0          | 60  | 4080             |                 |
| Lund           | 027               | 706.9          | 48  | 4128             |                 |
| Tonopah        | 320               | 440.1          | 1464  | 562              |                 |
| Bishop         | 276               | 668.2          | 13.2  | 138              | 94.2            |
| Beatty         | 244               | 210            | 1144  |                  |                 |
| Inyokern       | 221               | 699.1          | 10  | 80               | 124             |
|                |                   |                |   |                  |                 |
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(1)  $\Delta p > 12$  mb.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Hornet DATE 3 / 12 / 55 TIME 1320 Z  
 YIELD 3.6 kt BURST HEIGHT 300 ft. LOCATION T-3A  
 APPARENT BLAST YIELD ,  $W_a = 7.85$  kt,  $W_a^{0.4} = 2.28$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 193               | 39.1           | 13080   |                  |                 |
| Mercury        | 176               | 139.0          | 1560  |                  |                 |
| Indian Springs | 151               | 191.4          | 728   |                  |                 |
| Las Vegas      | 143               | 417.1          | 42.0  | 148.8            |                 |
| Boulder City   | 139               | 520.6          | 12.0  | 184.2            |                 |
| Glendale       | 110               | 459            | 94.8  | 202.8            |                 |
| Caliente       | 065               | 486.1          | 60  | 210              |                 |
| St. George     | 089               | 710.6          | 20  | 256              |                 |
| Lund           | 024               | 728.0          |   | 410              |                 |
| Tonopah        | 320               | 484.8          |   | 256.8            |                 |
| Bishop         | 279               | 700.3          |   | 120              | 60              |
| Inyokern       | 224               | 691.7          |   | 126.6            | 33.0            |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Bee DATE 3/22/55 TIME 1305 Z  
 YIELD 8.1 kt BURST HEIGHT 500 ft. LOCATION T-7-1  
 APPARENT BLAST YIELD,  $W_a = 19.05$  kt,  $W_a^{0.4} = 3.25$

| MB STATION     | AZIMUTH (DEG.) | RANGE (KFT) | RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS) |              |             |
|----------------|----------------|-------------|--|--------------|-------------|
|                |                |             | TROPO-SPHERE   | OZONO-SPHERE | IONO-SPHERE |
| CP-1           | 189            | 58.8        | 13200  |              |             |
| Mercury        | 177            | 158.7       | 7703   |              |             |
| Indian Springs | 154            | 208.7       | 5685   |              |             |
| Las Vegas      | 144            | 432.7       | 2904   | 216          |             |
| Henderson      | 141            | 493         | 2416   | 432          |             |
| Boulder City   | 140            | 542.5       | 1440   | 280          |             |
| Caliente       | 067            | 477.3       |  | 548          |             |
| St. George     | 091            | 709.7       | 36   | 3120         |             |
| Lund           | 025            | 709.7       |  | 900          |             |
| Tonopah        | 318            | 469.9       |  | 108          |             |
| Bishop         | 277            | 697.5       |  | 49.5         | 22.8        |
| Inyokern       | 223            | 706.1       | 12   | 24           |             |
|                |                |             |  |              |             |
|                |                |             |  |              |             |
|                |                |             |  |              |             |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT ESS DATE 3/23/55 TIME 2030 Z

YIELD 1.1 kt BURST HEIGHT -67 ft. LOCATION T-10

APPARENT BLAST YIELD,  $W_a =$  \_\_\_\_\_ kt,  $W_a^{0.4}$  \_\_\_\_\_

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 182               | 85.7           | 400   |                  |                 |
| FFT            | 176               | 133.2          | 384   |                  |                 |
| Mercury        | 176               | 186.4          | 230   |                  |                 |
| Indian Springs | 156               | 235.9          | 16  |                  |                 |
| Las Vegas      | 146               | 458.1          | <20 (1)   |                  |                 |
| Boulder City   | 141               | 559.7          |   | 63               |                 |
| Caliente       | 071               | 472.1          |   | 260              |                 |
| St. George     | 093               | 715.3          |   | 166              |                 |
| Lund           | 026               | 687.1          |   | 358              |                 |
| Tonopah        | 317               | 446.0          |   | <48 (1)          |                 |
| Bishop         | 275               | 688.6          |   | 12               | 6               |
| Inyokern       | 221               | 722.2          |   | 7.6              | 13              |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |

(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Apple-I DATE 3 /29 /55 TIME 1255 Z

YIELD 14.2 kt BURST HEIGHT 500 ft. LOCATION T-4

APPARENT BLAST YIELD ,  $W_a = 31.3$  kt,  $W_a^{0.4} = 3.96$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 167               | 59.9           | 6120  |                  |                 |
| Mercury        | 169               | 161.9          | 2240  | 280              |                 |
| Indian Springs | 149               | 220.2          | 3840  | 315              |                 |
| Las Vegas      | 142               | 446.9          | 2040  | 285              |                 |
| Boulder City   | 138               | 558.0          | 1624  | 488              |                 |
| Caliente       | 068               | 498.4          | 340   | 550              |                 |
| St. George     | 091               | 732.7          | 255   | 1452             |                 |
| Lund           | 026               | 719.1          | 632   | 760              |                 |
| Tonopah        | 320               | 454.9          |   | 160              |                 |
| Bishop         | 277               | 674.7          |   | 44.4             | 28.5            |
| Inyokern       | 222               | 690.4          |   | 192              | 36              |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Wasp-Prime DATE 3/29/55 TIME 1800 Z

YIELD 3.2 kt BURST HEIGHT 740 ft. LOCATION T-7-4

APPARENT BLAST YIELD,  $W_a = 11.6$  kt,  $W_a^{0.4} = 2.67$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 191               | 55.3           | 4068  |                  |                 |
| Mercury        | 177               | 154.9          | 204   | 42               |                 |
| Indian Springs | 154               | 205.0          | 408   | 187              |                 |
| Las Vegas      | 144               | 429.0          | > 320   | 248              |                 |
| Boulder City   | 140               | 531.7          | 696   | 583              |                 |
| Caliente       | 067               | 477.7          | 2320  | 496              | 160             |
| St. George     | 090               | 708.6          | 308   | 368              |                 |
| Tonopah        | 318               | 473.5          |   | 35               |                 |
| Bishop         | 277               | 703.9          |   | 14.4             | 24.0            |
| Inyokern       | 224               | 699.6          |   | 91.8             |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
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|                |                   |                |   |                  |                 |

# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT HA DATE 4/6/55 TIME 1800 Z

YIELD 3.3 kt BURST HEIGHT 36,620 ft. LOCATION T-5G

APPARENT BLAST YIELD,  $W_a = 3.3$  kt,  $W_a^{0.4} = 1.612$

| MB STATION     | AZIMUTH (DEG.) | RANGE (KFT) | RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS) |              |             |
|----------------|----------------|-------------|--|--------------|-------------|
|                |                |             | TROPO-SPHERE   | OZONO-SPHERE | IONO-SPHERE |
| CP-1-P (1)     | 179            | 47.0        | 13200  |              |             |
| FFT-P (1)      | 170            | 89.2        | 7760 (2)   |              |             |
| MER-P (1)      | 172            | 140.0       | 2208 (2)   |              |             |
| Indian Springs | 148            | 192.5       | 1002   |              |             |
| Las Vegas      | 141            | 419.7       | 42   | 138          |             |
| Boulder City   | 138            | 531.2       |  | 572          |             |
| Caliente       | 065            | 496.4       |  | 474          |             |
| St. George     | 089            | 720.3       |  | 756          |             |
| Lund           | 025            | 735.7       |  | 204          |             |
| Tonopah        | 321            | 482.1       |  | 65.4         |             |
| Bishop         | 279            | 691.8       |  |              | 54.0        |
| Inyokern       | 224            | 681.9       |  | 20           | 78          |
|                |                |             |  |              |             |
|                |                |             |  |              |             |
|                |                |             |  |              |             |
|                |                |             |  |              |             |
|                |                |             |  |              |             |

(1) MB sensor on 40-foot pole.

(2) No step recorded to show reflected wave.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Post DATE 4/9/55 TIME 1230 Z

YIELD 1.5 kt BURST HEIGHT 300 ft. LOCATION T-9C

APPARENT BLAST YIELD,  $W_a = 3.6$  kt,  $W_a^{0.4} = 1.67$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| OBA            | 183               | 63.7           | 7200  |                  |                 |
| CP-1           | 185               | 68.4           | 4680  |                  |                 |
| Mercury        | 176               | 168.9          | 340   |                  |                 |
| Indian Springs | 154               | 219.0          | 180   |                  |                 |
| Las Vegas      | 145               | 442.6          | 87  |                  |                 |
| Boulder City   | 141               | 552.1          |   | 342              |                 |
| Caliente       | 069               | 476.3          |   | 207              |                 |
| St. George     | 092               | 712.7          |   | 1014             |                 |
| Lund           | 025               | 701.9          |   | 626              |                 |
| Tonopah        | 318               | 460.4          | 3.6   | 58.2             |                 |
| Bishop         | 276               | 693.0          |   | 19.2             | 10.2            |
| Inyokern       | 222               | 711.1          |   | 51.0             |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |



# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT MET DATE 4/15/55 TIME 1915 Z

YIELD 22.0 kt BURST HEIGHT 400 ft. LOCATION FF

APPARENT BLAST YIELD,  $W_a = 45.1$  kt,  $W_a^{0.4} 4.58$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 323               | 61.7           | >8880 (1)   |                  |                 |
| OBA            | 200               | 34.5           | 24400   |                  |                 |
| Mercury        | 200               | 53.3           | >>3200  |                  |                 |
| Indian Springs | 141               | 102.0          | >3200 (2)   |                  |                 |
| Las Vegas      | 137               | 331.6          | 410   | 256              |                 |
| Boulder City   | 134               | 437.9          | 110   | 552              |                 |
| Caliente       | 055               | 507.3          | 1200  | 320              |                 |
| St. George     | 082               | 691.7          | 354   | 4540             |                 |
| Lund           | 020               | 800.2          | 48.0  | 714              | 60              |
| Tonopah        | 323               | 571.9          |   | 554              |                 |
| Bishop         | 285               | 748.2          |   | 114              |                 |
| Inyokern       | 232               | 654.9          |   | 290              | 98              |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |
|                |                   |                |   |                  |                 |

(1) Estimated 11,000.

(2) Estimated 3,600.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Apple-II DATE 5/ 5 /55 TIME 1210 Z  
 YIELD 28.5 kt BURST HEIGHT 500 ft. LOCATION T-1  
 APPARENT BLAST YIELD ,  $W_a = 59.9$  kt,  $W_a^{0.4}$  5.14

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 162               | 44.8           | 21300   |                  |                 |
| Mercury        | 167               | 146.6          | 620   |                  |                 |
| Indian Springs | 146               | 207.0          | 182.4   | 256              |                 |
| Las Vegas      | 141               | 434.9          | 492   | 422              | 70.8            |
| Boulder City   | 147               | 546.7          |   | 960              | 80              |
| Caliente       | 067               | 504.5          | 84.8  | >160             | 71.0            |
| St. George     | 090               | 733.0          |   | >840             | 125.4           |
| Lincoln Mine   | 027               | 238            | 5112  |                  |                 |
| Lund           | 026               | 733.0          | 724   | 416              |                 |
| Tonopah        | 322               | 467.1          | 1960  | 120              | 304             |
| Bishop         | 279               | 677.3          |   | 744              | 69.0            |
| Inyokern       | 223               | 679.2          |   | 500              |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Zucchini DATE 5/15/55 TIME 1200 Z

YIELD 28.2 kt BURST HEIGHT 500 ft. LOCATION T-7-1

APPARENT BLAST YIELD,  $W_a = 59.2$  kt,  $W_a^{0.4} 5.10$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1           | 189               | 58.8           | 12480   |                  |                 |
| Mercury        | 177               | 158.7          | 2100  |                  |                 |
| Indian Springs | 154               | 208.7          | 825   |                  |                 |
| Las Vegas      | 154               | 432.7          | 664   | 160              |                 |
| Boulder City   | 140               | 535.3          | 480   | 260              |                 |
| Glendale       | 110               | 458            | 1170  |                  |                 |
| Caliente       | 067               | 477.3          | 1830  | 120              |                 |
| St. George     | 091               | 709.7          | 1680  | 120              |                 |
| Lund           | 025               | 709.7          | 300   | 870              |                 |
| Tonopah        | 318               | 469.9          | 155.4   | 295.2            |                 |
| Bishop         | 277               | 697.5          |   | 540              |                 |
| Inyokern       | 223               | 706.1          |   | 460              |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Boltzmann DATE 5 / 28 / 57 TIME 1155 Z

YIELD 11.5 kt BURST HEIGHT 500 ft. LOCATION T-7C

APPARENT BLAST YIELD,  $W_a = 26.1$  kt,  $W_a^{0.4} 3.69$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 189               | 58.8           | 5976  |                  |                 |
| Las Vegas     | 143               | 423.9          |   | 202.2            |                 |
| Boulder City  | 140               | 535.3          |   | 177.0            | 34.2            |
| St. George    | 091               | 709.7          |   | 92.4             | 76.2            |
| Tonopah       | 318               | 469.9          | 48  | 268              |                 |
| Bishop        | 277               | 697.5          | 12  | 480              |                 |
| Inyokern      | 223               | 701.4          |   | 1152             | 26.0            |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Franklin DATE 6/2/57 TIME 1155 Z

YIELD 0.14 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD,  $W_a = 0.569$  kt,  $W_a^{0.4} = 0.798$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 194               | 41.9           | 6800  |                  |                 |
| Las Vegas     | 141               | 410.8          | 3.0   | 24.6             |                 |
| Boulder City  | 139               | 521.9          | 1.2   | 24.6             |                 |
| St. George    | 089               | 709.3          |   | 6.6              | 21.0            |
| Tonopah       | 320               | 483.5          | 6   | 48               |                 |
| Bishop        | 279               | 701.1          |   | 254.4            |                 |
| Inyokern      | 224               | 689.8          |   | 568              | 20              |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Lassen DATE 6 / 5 / 57 TIME 1145 Z

YIELD 0.47-ton BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD,  $W_a = 4.7 \times 10^{-4}$  kt,  $W_a^{0.4} = 4.97 \times 10^{-2}$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 184               | 73.2           | 80  |                  |                 |
| Las Vegas     | 144               | 445.8          |   | 0.4              |                 |
| Boulder City  | 140               | 548.3          |   | 0.4 (1)          |                 |
| St. George    | 092               | 716.5          |   | 0.4 (1)          |                 |
| Tonopah       | 318               | 457.0          |   | 0.8              |                 |
| Bishop        | 277               | 689.0          |   | 14               |                 |
| Inyokern      | 222               | 704.7          |   | 6.0              |                 |
|               |                   |                |   |                  |                 |
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(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Wilson DATE 6/18/57 TIME 1145 Z

YIELD 10.3 kt BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD,  $W_a = 23.4$  kt,  $W_a^{0.4} = 3.52$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 177               | 72.7           | 4620  |                  |                 |
| Las Vegas     | 144               | 447.4          | 17.4  | 97.8             |                 |
| Boulder City  | 140               | 549.6          |   | 75.0             |                 |
| St. George    | 092               | 714.9          | 149.4   | 40.2             | 82.2            |
| Lund          | 025               | 698.8          | 30.6  | 218.4            |                 |
| Tonopah       | 318               | 455.8          | 26  | 182              |                 |
| Bishop        | 277               | 690.4          |   | 1160             |                 |
| Inyokern      | 222               | 708.3          |   | 800              | 24              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Priscilla DATE 6/24/57 TIME 1330 Z  
 YIELD 36.6 kt BURST HEIGHT 700 ft. LOCATION B-FF  
 APPARENT BLAST YIELD,  $W_a = 81.7$  kt,  $W_a^{0.4} = 5.80$

| MB STATION   | AZIMUTH (DEG.) | RANGE (KFT) | RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS) |              |             |
|--------------|----------------|-------------|--|--------------|-------------|
|              |                |             | TROPO-SPHERE   | OZONO-SPHERE | IONO-SPHERE |
| CP-1         | 323            | 61.7        | 24000 (1)  |              |             |
| Mercury      | 200            | 53.3        | 12960 (2)  |              |             |
| Las Vegas    | 135            | 325.4       | 85.2   | 112.2        | 25.8        |
| Boulder City | 134            | 437.9       | 26.4   | 96.0         |             |
| St. George   | 082            | 691.7       | 14.4   | 58.8         | 66.0        |
| Lund         | 020            | 800.1       | 6.0  | 120          | 38          |
| Tonopah      | 323            | 571.9       |  | 704          |             |
| Bishop       | 285            | 748.7       |  | 1650         | 144         |
| Inyokern     | 232            | 650.4       |  | 1566         |             |
| San Diego    | 196            | 1528        |  | (3)          |             |
|              |                |             |  |              |             |
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(1)  $\Delta p = 17.52 \text{ mb} = 0.254 \text{ lb/in.}^2$ .

(2) Door torn off house at Indian Springs, no MB recorder.

(3) No MB recorder, audible disturbance.



# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Hood DATE 7 / 5 / 57 TIME 1140 Z

YIELD 74.3 kt BURST HEIGHT 1500 ft. LOCATION B-9A

APPARENT BLAST YIELD,  $W_a = 208.5$  kt,  $W_a^{0.4} = 8.46$

| MB<br>STATION  | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|----------------|-------------------|----------------|---|------------------|-----------------|
|                |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| Indian Springs | 155               | 224.1          | 540   |                  |                 |
| Las Vegas      | 145               | 447.4          | 30  | 198              | 42              |
| Boulder City   | 140               | 549.6          |   | 126              | 57              |
| St. George     | 092               | 714.9          | 24  | 73.1             | 168             |
| Lund           | 025               | 698.8          | 269   | 365              | 221             |
| Tonopah        | 318               | 455.8          | 610   | 390              |                 |
| Bishop C       | 277               | 690.4          |   | 2760             | 90              |
| Bishop F       | 277               | 694.6          |   | 2280             |                 |
| Inyokern       | 222               | 708.3          |   | 1728             | 108             |
| Gov't Peak     | 226               | 790            |   | 3240             | 108             |
| Daggett        | 203               | 765            |   | 928              | 156             |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Diablo DATE 7 /15 / 57 TIME 1130 Z

YIELD 17.0 kt BURST HEIGHT 500 ft. LOCATION T-2B

APPARENT BLAST YIELD,  $W_a = 37.1$  kt,  $W_a^{0.4} = 4.24$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 166               | 79.8           | 8150  |                  |                 |
| Las Vegas     | 143               | 463.7          | 7.2   | 113.2            | 10.2            |
| Boulder City  | 139               | 566.8          |   | 54               | 40.8            |
| St. George    | 092               | 734.8          |   | 15.6             | 93.5            |
| Lund          | 027               | 702.0          | 12  | 97               | 104             |
| Tonopah       | 320               | 438.3          | 182   | 64.8             |                 |
| Bishop C      | 276               | 670.2          |   | 1040             |                 |
| Bishop F      | 276               | 674.9          |   | 1616             |                 |
| Inyokern      | 221               | 699.7          |   | 1768             | 50              |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT John DATE 7 /19 /57 TIME 1400 Z

YIELD 2 kt BURST HEIGHT 30,000 ft. LOCATION A-9

APPARENT BLAST YIELD ,  $W_a = 2$  kt,  $W_a^{0.4}$  1.32

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK - TO - PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                   |                  |
|---------------|-------------------|----------------|---|-------------------|------------------|
|               |                   |                | TROPO -<br>SPHERE   | OZONO -<br>SPHERE | IONO -<br>SPHERE |
| CP-1          | 177               | 74.4           | 2440  |                   |                  |
| Las Vegas     | 144               | 447.4          | 3.0   | 73.2              |                  |
| Boulder City  | 140               | 549.6          |   | 66                | 12               |
| St. George    | 092               | 714.9          |   | 34.2              | 45               |
| Lund          | 025               | 698.8          | 22.8  | 52.8              | 63               |
| Tonopah       | 318               | 455.8          | 6   | 60.2              |                  |
| Coaldale      | 302               | 618.5          |   | 284               | 20               |
| Bishop        | 277               | 690.4          |   | 556               |                  |
| Inyokern      | 222               | 708.3          |   | 800               | 40               |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Kepler DATE 7/24/57 TIME 1150 Z  
 YIELD 10.3 kt BURST HEIGHT 500 ft. LOCATION T-4  
 APPARENT BLAST YIELD,  $W_a = 23.5$  kt,  $W_a^{0.4} = 3.53$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 167               | 59.9           | 14320   |                  |                 |
| Las Vegas     | 140               | 434.9          | 22  | 96               |                 |
| Boulder City  | 138               | 551.8          | 57  | 128              |                 |
| St. George    | 091               | 734.5          |   | 34               | 72              |
| Lund          | 026               | 720.0          | 18.4  | 160              | 52              |
| Tonopah       | 320               | 450.0          | 37.2  | 198              |                 |
| Coaldale      | 304               | 618            |   | 870              |                 |
| Sodaville     | 308               | 792            |   | 1020             |                 |
| Bishop        | 278               | 674.8          |   | 840              |                 |
| Inyokern      | 222               | 685.0          |   | 1332             |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Owens DATE 7/25/57 TIME 1330 Z  
 YIELD 9.7 kt BURST HEIGHT 500 ft. LOCATION B-9A  
 APPARENT BLAST YIELD,  $W_a = 22.2$  kt,  $W_a^{0.4} = 3.46$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 183               | 72.7           | 7740  |                  |                 |
| Las Vegas     | 144               | 447.4          | 57  |                  |                 |
| Boulder City  | 140               | 549.6          |   | 39               | 33              |
| St. George    | 092               | 714.9          | 9.6   | 29               | 78              |
| Lund          | 025               | 698.8          | 10.7  | 12.0             |                 |
| Tonopah       | 318               | 455.8          | 110   | 246              |                 |
| Sodaville     | 306               | 725.5          |   | 870              |                 |
| Bishop C      | 277               | 690.4          |   | 690              |                 |
| Bishop F      | 277               | 693            |   | 780              | 90              |
| Inyokern      | 222               | 708.3          |   | 780              |                 |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Stokes DATE 8 / 7 / 57 TIME 1225 Z  
 YIELD 19.1 kt BURST HEIGHT 1500 ft. LOCATION B-7B  
 APPARENT BLAST YIELD ,  $W_a = 76.0$  kt,  $W_a^{0.4} = 5.66$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 185               | 48.7           | >16000  |                  |                 |
| CP-1          | 189               | 55.8           | 16640   |                  |                 |
| Las Vegas     | 144               | 430.2          | 8.0   | 89.6             |                 |
| Boulder City  | 140               | 532.9          |   | 81.0             |                 |
| St. George    | 091               | 709.2          | 11.6  | 43.4             | 70.4            |
| Lund          | 025               | 712.4          | 797   | 157              | 37.8            |
| Tonopah       | 318               | 472.2          | 725   | 178.2            |                 |
| Bishop        | 277               | 697.8          |   | 1440             |                 |
| Inyokern C    | 223               | 694.2          |   | 638              | 100             |
| Inyokern F    | 223               | 698.9          |   | 896              |                 |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Shasta DATE 8 / 18 / 57 TIME 1200 Z

YIELD 16.5 kt BURST HEIGHT 500 ft. LOCATION T-2A

APPARENT BLAST YIELD ,  $W_a = 35.8$  kt,  $W_a^{0.4} 4.19$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 165               | 64             | 10640   |                  |                 |
| CP-1          | 166               | 71.6           | 7360  |                  |                 |
| Las Vegas     | 143               | 456.7          | 28.8  | 147              |                 |
| Boulder City  | 139               | 560.0          | 12  | 152              | 7.2             |
| St. George    | 092               | 733.7          | 1.8   | 48               | 48              |
| Lund          | 027               | 709.1          | 36  | 391              | 36              |
| Tonopah       | 320               | 445.1          | 1103  | 220              |                 |
| Bishop        | 276               | 671.9          | 48  | 486              | 48              |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Doppler DATE 8/23/57 TIME 1230 Z  
 YIELD 10.7 kt BURST HEIGHT 1500 ft. LOCATION B-7B  
 APPARENT BLAST YIELD,  $W_a = 49.0$  kt,  $W_a^{0.4} = 4.74$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 185               | 48.7           | 17640   |                  |                 |
| CP-1          | 189               | 55.8           | 13500   |                  |                 |
| Las Vegas     | 144               | 430.2          | 1.8   | 141              |                 |
| Boulder City  | 140               | 532.9          | 1.2   | 165              |                 |
| St. George    | 091               | 709.2          | 6   | 51.6             | 85.7            |
| Lund          | 025               | 712.4          | 30  | 180              | 50              |
| Tonopah       | 318               | 472.2          | 428   | 222.4            |                 |
| Bishop        | 277               | 697.8          |   | 780              | 48              |
| Inyokern      | 223               | 698.9          |   | 948              | 54              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Franklin Prime DATE 8/30/57 TIME 1240 Z  
 YIELD 4.7 kt BURST HEIGHT 750 ft. LOCATION B-7B  
 APPARENT BLAST YIELD,  $W_a = 10.44$  kt,  $W_a^{0.4} = 2.56$

| MB STATION   | AZIMUTH (DEG.) | RANGE (KFT) | RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS) |              |             |
|--------------|----------------|-------------|--|--------------|-------------|
|              |                |             | TROPO-SPHERE   | OZONO-SPHERE | IONO-SPHERE |
| UCC          | 185            | 48.7        | 5220   |              |             |
| CP-1         | 189            | 55.8        | 6160   |              |             |
| Las Vegas    | 144            | 430.2       | 11   | 92.8         |             |
| Boulder City | 140            | 532.9       |  | 151.2        |             |
| St. George   | 091            | 709.2       | 16   | 66.2         | 46          |
| Lund         | 025            | 712.4       | 24   | 120          | 33          |
| Tonopah      | 318            | 472.2       | 66   | 158          |             |
| Bishop       | 277            | 697.8       |  | 944          | 40          |
| Inyokern     | 223            | 698.9       |  | 620          | 90          |
| Daggett      | 203            | 790         |  | 570          | 100         |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Smokey DATE 8/31/57 TIME 1230 Z  
 YIELD 44 kt BURST HEIGHT 700 ft. LOCATION T-2C  
 APPARENT BLAST YIELD,  $W_a = 96.5$  kt,  $W_a^{0.4} = 6.22$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 190               | 91.8           | 15200   |                  |                 |
| Las Vegas     | 143               | 467.6          | 138   | 204              |                 |
| Boulder City  | 139               | 585.2          | 60  | 204              | 16              |
| St. George    | 092               | 723.8          | 234   | 167              | 42.6            |
| Lund          | 027               | 684.8          | 4.8   | 317              | 84.5            |
| Tonopah       | 320               | 435.6          | 7.2   | 660              |                 |
| Bishop        | 276               | 680.5          |   | 1080             | 280             |
| Inyokern      | 221               | 717.5          |   | 918              | 96              |
| Daggett       | 203               | 790            | 108   | 900              | 90              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Galileo DATE 9/2 /57 TIME 1240 Z

YIELD 11.4 kt BURST HEIGHT 500 ft. LOCATION T-1

APPARENT BLAST YIELD ,  $W_a = 25.7$  kt,  $W_a^{0.4} = 3.66$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 160               | 38.5           | 38300   |                  |                 |
| CP-1          | 162               | 44.8           | 16680   |                  |                 |
| Las Vegas     | 141               | 427.7          | 21  | 156              | 24              |
| Boulder City  | 137               | 539.5          | 6   | 156              | 6               |
| St. George    | 090               | 733.0          |   | 108              |                 |
| Lund          | 026               | 733.0          | 12  | 408              | 158             |
| Tonopah       | 322               | 467.1          | 186   | 504              |                 |
| Bishop        | 279               | 677.3          |   | 420              | 18              |
| Inyokern      | 223               | 674.6          |   | 510              | 60              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Wheeler DATE 9/ 6 /57 TIME 1245 Z

YIELD 0.197 kt BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD ,  $W_a = 1.025$  kt,  $W_a^{0.4} = 1.01$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 180               | 64.1           | 3200  |                  |                 |
| CP-1          | 183               | 72.7           | 1710  |                  |                 |
| Las Vegas     | 144               | 447.4          |   | 28.6             |                 |
| Boulder City  | 140               | 549.6          | 1.2   | 41.0             |                 |
| St. George    | 092               | 714.9          |   | 30               |                 |
| Lund          | 025               | 698.8          | 12  | 180              |                 |
| Tonopah       | 318               | 455.8          | 123   | 18               |                 |
| Bishop        | 277               | 690.4          | 3.0   | 45               | 15              |
| Inyokern      | 222               | 708.3          |   | 50               | 30              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT LaPlace DATE 9/8 /57 TIME 1300 Z

YIELD <sup>(Not released)</sup> kt BURST HEIGHT 750 ft. LOCATION B-7B

APPARENT BLAST YIELD,  $W_a =$                       kt,  $W_a^{0.4}$                      

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 185               | 48.7           | 12600   |                  |                 |
| CP-1          | 189               | 55.8           | 5600  |                  |                 |
| Las Vegas     | 144               | 430.2          | 10  | 52               |                 |
| Boulder City  | 140               | 532.9          |   | 150              |                 |
| St. George    | 091               | 709.2          | 3   | 41               | 14              |
| Lund          | 025               | 712.4          | 6   | 60               | 6               |
| Tonopah       | 318               | 472.2          | 15  | 79.5             | 33              |
| Bishop        | 277               | 697.8          | 6   | 240              | 15              |
| Inyokern      | 223               | 698.9          |   | 492              | 66              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Fizeau DATE 9 / 14 / 57 TIME 1645 Z

YIELD 11.1 kt BURST HEIGHT 500 ft. LOCATION T-3B

APPARENT BLAST YIELD,  $W_a = 25.3$  kt,  $W_a^{0.4} 3.64$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 190               | 29.0           | 30480   |                  |                 |
| Las Vegas     | 143               | 417.1          | 30.6  | 141              | 15              |
| Boulder City  | 139               | 520.6          | 12.6  | 216              |                 |
| St. George    | 089               | 710.6          | 4.8   | 171              | 98.4            |
| Lund          | 024               | 728.0          | 2.4   | 163.2            | 45              |
| Tonopah       | 320               | 484.8          | 18  | 121.8            |                 |
| Bishop        | 279               | 700.3          |   | 280              | 76              |
| Inyokern      | 224               | 691.7          |   | 346              | 30              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Newton DATE 9 /16 /57 TIME 1250 Z

YIELD 12 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD ,  $W_a = 53.6$  kt,  $W_a^{0.4} 4.91$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 189               | 55.8           | 11100   |                  |                 |
| Las Vegas     | 144               | 430.2          | 96  | 133.5            |                 |
| Boulder City  | 140               | 532.9          | 50  | 195              |                 |
| Glendale      | 110               | 448            | 475   | 90               |                 |
| St. George    | 091               | 709.2          | 496   | 128              |                 |
| Lund          | 025               | 712.4          | 56  | 220              | 34              |
| Tonopah       | 318               | 472.2          | 6   | 396              |                 |
| Bishop        | 277               | 697.8          |   | 550              | 70              |
| Inyokern      | 223               | 698.9          |   | 1000             | 100             |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Rainier DATE 9/19/57 TIME 1700 Z

YIELD 1.7 kt BURST HEIGHT -790 ft. LOCATION U-126

APPARENT BLAST YIELD,  $W_a =$  \_\_\_\_\_ kt,  $W_a^{0.4}$  \_\_\_\_\_

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 151               | 95             | (1)   |                  |                 |
| CP-1          | 154               | 101.5          | (1)   |                  |                 |
| Las Vegas     | 141               | 483.1          | (1)   |                  |                 |
| Boulder City  | 138               | 591.4          | (1)   |                  |                 |
| St. George    | 092               | 761            | 2.4   |                  |                 |
| Lund          | 029               | 707.5          | (1)   |                  |                 |
| Tonopah       | 318               | 467.3          |   | (1)              |                 |
| Bishop        | 276               | 652.1          |   | 5.4              |                 |
| Inyokern      | 219               | 699.6          |   | (1)              |                 |
|               |                   |                |   |                  |                 |
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(1) No signal/noise.



# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Whitney DATE 9 / 23 / 57 TIME 1230 Z  
 YIELD 18.5 kt BURST HEIGHT 500 ft. LOCATION T-2  
 APPARENT BLAST YIELD,  $W_a = 40.0$  kt,  $W_a^{0.4} = 4.37$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 163               | 69.3           | 5400  |                  |                 |
| CP-1          | 166               | 76.2           | 4300  |                  |                 |
| Las Vegas     | 143               | 454.2          | 12  | 210              | 18              |
| Boulder City  | 139               | 565.3          | 30  | 280              |                 |
| St. George    | 092               | 737.0          | 9.0   | 336              |                 |
| Lund          | 027               | 706.9          | 49.2  | 696              |                 |
| Tonopah       | 320               | 440.1          | 300   | 210              |                 |
| Bishop        | 276               | 668.1          |   | 340              | 120             |
| Inyokern      | 221               | 694.4          |   | 330              | 20              |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Charleston DATE 9/28 /57 TIME 1300 Z

YIELD 11.5 kt BURST HEIGHT 1500 ft. LOCATION B-9A

APPARENT BLAST YIELD ,  $W_a = 52.6$  kt,  $W_a^{0.4} = 4.88$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 183               | 72.7           | 4680  |                  |                 |
| Las Vegas     | 145               | 447.4          |   | 156              |                 |
| Boulder City  | 140               | 549.6          |   | 408              |                 |
| St. George    | 092               | 714.9          | 30  | 268              | 20              |
| Lincoln Mine  | 022               | 164            | 5160  |                  |                 |
| Lund          | 025               | 698.8          | 1069  | 180              |                 |
| Tonopah       | 318               | 455.8          | 96  | 90               |                 |
| Bishop        | 277               | 690.4          |   | 152              | 34              |
| Inyokern      | 222               | 708.3          |   | 318              | 48              |
| Daggett       | 203               | 865            |   | 190              | 76              |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Morgan DATE 10/6/57 TIME 1300 Z  
 YIELD 8 kt BURST HEIGHT 500 ft. LOCATION B-9A  
 APPARENT BLAST YIELD,  $W_a = 18.96$  kt,  $W_a^{0.4} = 3.24$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 183               | 72.7           | 8640  |                  |                 |
| Las Vegas     | 145               | 447.4          |   | 148              |                 |
| Boulder City  | 140               | 549.6          | 84  | 376              |                 |
| Alamo         | 069               | 275            | >960  |                  |                 |
| Coyote        | 064               | 317            | 2320  |                  |                 |
| St. George    | 092               | 714.9          | 480   | 422              |                 |
| Lund          | 025               | 698.8          | 367   | 542              |                 |
| Tonopah       | 318               | 455.8          | 206   | 168              |                 |
| Bishop        | 277               | 690.4          |   | 42.0             | 57.6            |
| Inyokern      | 222               | 708.3          |   | 145.2            | 15              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Eddy DATE 9 / 19 / 58 TIME 1400 Z

YIELD 83-ton BURST HEIGHT 500 ft. LOCATION B-7B

APPARENT BLAST YIELD ,  $W_a = 0.34$  kt,  $W_a^{0.4} = 0.65$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 185               | 46.5           | 3040  |                  |                 |
| CP-1          | 189               | 55.0           | 2588  |                  |                 |
| MOB           | 189               | 55.8           | 1880  |                  |                 |
| Las Vegas     | 144               | 430.2          | 1.2   | 11               |                 |
| Boulder City  | 140               | 532.9          | 0.8   | 11.8             |                 |
| St. George    | 091               | 709.2          |   | 12.8             |                 |
| Bishop        | 277               | 697.8          |   | 66.6             |                 |
| Inyokern      | 223               | 698.9          |   | 48.6             | 4.8             |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Mora DATE 9 /29 / 58 TIME 1405 Z

YIELD 2 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD ,  $W_a = 7.76$  kt,  $W_a^{0.4} = 2.27$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 189               | 55.8           | 17500   |                  |                 |
| FFO           | 178               | 143            | 6020  |                  |                 |
| Las Vegas     | 144               | 430.2          | 210   | 60               |                 |
| Boulder City  | 140               | 532.9          | 28  | 50               |                 |
| St. George    | 091               | 709.2          |   | 408              |                 |
| Bishop        | 277               | 697.8          |   | 71.4             | 18              |
| Inyokern      | 223               | 698.9          | 10  | 176              | 44              |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Hidalgo DATE 10/ 5 /58 TIME 1410 Z  
 YIELD 77-ton BURST HEIGHT 377 ft. LOCATION B-7B  
 APPARENT BLAST YIELD ,  $W_a = 0.393$  kt,  $W_a^{0.4} = 0.689$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 185               | 46.5           | 2540  |                  |                 |
| CP-1          | 189               | 55.8           | 2640  |                  |                 |
| Las Vegas     | 144               | 430.2          | 18  | 5.8              |                 |
| Boulder City  | 140               | 532.9          | 28.4  | 34               |                 |
| St. George    | 091               | 709.2          |   | 53.4             |                 |
| Bishop        | 277               | 697.8          |   | 6                | 9               |
| Inyokern      | 223               | 698.9          |   | 6.6              | 29              |
|               |                   |                |   |                  |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Quay DATE 10/10/58 TIME 1430 Z  
 YIELD 79-ton BURST HEIGHT 100 ft. LOCATION T-7C  
 APPARENT BLAST YIELD ,  $W_a = 0.182$  kt,  $W_a^{0.4} = 0.506$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 191               | 43.6           | 3180  |                  |                 |
| CP-1          | 188               | 59.0           | 4250  |                  |                 |
| Las Vegas     | 144               | 432.9          |   | 14               |                 |
| Boulder City  | 140               | 535.5          |   | 22               |                 |
| St. George    | 091               | 709.5          | 3.2   | 217.6            | 7.0             |
| Bishop        | 278               | 697.1          |   | 4.5              |                 |
| Inyokern      | 223               | 701.2          |   | 7.0              |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Lea DATE 10/ 13/ 58 TIME 1320 Z  
 YIELD 1.4 kt BURST HEIGHT 1500 ft. LOCATION B-7B  
 APPARENT BLAST YIELD ,  $W_a = 4.37$  kt,  $W_a^{0.4} 1.80$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 185               | 55.8           | 7200  |                  |                 |
| CP-1M         | 185               | 55.8           | 6300  |                  |                 |
| Las Vegas     | 144               | 430.2          | 10.6  | 59               |                 |
| Boulder City  | 140               | 531.7          |   | 102              |                 |
| St. George    | 091               | 709.2          |   | 344              |                 |
| Bishop        | 278               | 697.8          |   | 30.6             | 26.4            |
| Inyokern      | 223               | 698.9          |   | 57.0             | 18.4            |
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## MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Hamilton DATE 10/15/58 TIME 1600 Z

YIELD 1.17-ton BURST HEIGHT 50 ft. LOCATION FF-T-1

APPARENT BLAST YIELD,  $W_a = \underline{4.11 \times 10^{-3}} \text{ kt}$ ,  $W_a^{0.4} \underline{0.111}$

[illegible]

(1) No signal/noise.

## MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Dona Ana DATE 10/16/58 TIME 1420 Z

YIELD 37-ton      BURST HEIGHT 500 ft.      LOCATION B-7B

APPARENT BLAST YIELD,  $W_a = 0.0904$  kt,  $W_a^{0.4} = 0.373$

[illegible]

(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Rio Arriba DATE 10/18/58 TIME 1425 Z

YIELD 90-ton BURST HEIGHT 70 ft. LOCATION T-3S

APPARENT BLAST YIELD,  $W_a = 0.187$  kt,  $W_a^{0.4} = 0.512$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 190               | 32.9           | 3600  |                  |                 |
| CP-1          | 194               | 41.8           | 2400  |                  |                 |
| Las Vegas     | 143               | 418.6          | 4   | 18               |                 |
| Boulder City  | 139               | 529.1          |   | 33               |                 |
| St. George    | 089               | 709.3          | 6   | 216              |                 |
| Bishop        | 279               | 701.1          |   | 2                | 13              |
| Inyokern      | 224               | 689.8          |   | (1)              |                 |
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(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Vesta DATE 10/ 18/ 58 TIME 2300 Z

YIELD 24-ton BURST HEIGHT 0 ft. LOCATION GG-9

APPARENT BLAST YIELD ,  $W_a = 0.0456$  kt,  $W_a^{0.4} 0.290$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK - TO - PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                   |                  |
|---------------|-------------------|----------------|---|-------------------|------------------|
|               |                   |                | TROPO -<br>SPHERE   | OZONO -<br>SPHERE | IONO -<br>SPHERE |
| BJY           | 205               | 22.3           | 630   |                   |                  |
| CP-1          | 184               | 69.9           | 37.0  |                   |                  |
| Las Vegas     | 145               | 446            |   | 3.6               |                  |
| Boulder City  | 141               | 556            |   | 11.4              |                  |
| St. George    | 092               | 714            | >96   |                   |                  |
| Bishop        | 276               | 691            | 12  | <6 (1)            |                  |
| Inyokern      | 222               | 708            |   | 3                 |                  |
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(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Socorro DATE 10/22/58 TIME 1330 Z  
 YIELD 6 kt BURST HEIGHT 1500 ft. LOCATION B 7B  
 APPARENT BLAST YIELD,  $W_a = 30.36$  kt,  $W_a^{0.4} 3.92$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 187               | 47.5           | 22800   |                  |                 |
| CP-1          | 190               | 55.8           | 18960   |                  |                 |
| Las Vegas     | 144               | 430.2          | 160.8   | 146.4            |                 |
| Boulder City  | 140               | 532.9          | 64.2  | 237.6            |                 |
| Coyote        | 050               | 233            | 3624  |                  |                 |
| St. George    | 091               | 709.2          | 240   | 1398             | 60              |
| Bishop        | 278               | 697.8          |   | 1.62             | 12.6            |
| Inyokern      | 223               | 698.9          |   | 13               | 16              |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Wrangell DATE 10/22/58 TIME 1650 Z

YIELD 0.115 kt BURST HEIGHT 1500 ft. LOCATION B-FF

APPARENT BLAST YIELD,  $W_a = 0.115$  kt,  $W_a^{0.4} = 0.421$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 323               | 61.7           | 3720  |                  |                 |
| UCC           | 328               | 67.9           | 3540  |                  |                 |
| Las Vegas     | 135               | 325.4          | 33.0  | 9.6              |                 |
| Boulder City  | 134               | 437.9          | 17.4  | 18.6             |                 |
| Coyote        | 033               | 288            | 3540  |                  |                 |
| St. George    | 082               | 691.7          |   | 210              |                 |
| Bishop        | 285               | 748.7          | 9   |                  | 12              |
| Inyokern      | 232               | 650.4          |   | <4 (1)           |                 |
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(1) No signal/noise.

# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Rushmore DATE 10/22 /58 TIME 2340 Z

YIELD 0.188 kt BURST HEIGHT 500 ft. LOCATION B-9B

APPARENT BLAST YIELD ,  $W_a = 0.960$  kt,  $W_a^{0.4} 0.984$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 180               | 64.2           | 600   |                  |                 |
| CP-1          | 183               | 72.7           | 440   |                  |                 |
| Las Vegas     | 145               | 447.4          | 5.0   | 26.0             |                 |
| Boulder City  | 140               | 549.6          | 2.0   | 92               | 11              |
| Coyote        | 050               | 225            | 330   |                  |                 |
| St. George    | 092               | 714.9          |   | 220              |                 |
| Bishop        | 277               | 690.4          |   |                  | 36              |
| Inyokern      | 222               | 708.3          |   | 2                |                 |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Catron DATE 10/24/58 TIME 1500 Z

YIELD 0.021 kt BURST HEIGHT 72.5 ft. LOCATION T-3

APPARENT BLAST YIELD,  $W_a = 0.0498$  kt,  $W_a^{0.4} = 0.299$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 190               | 27.3           | 4800  |                  |                 |
| CP-1          | 194               | 41.8           | 3120  |                  |                 |
| Las Vegas     | 143               | 410.8          | 2.7   | 11.5             | 14              |
| Boulder City  | 139               | 521.9          |   | 21               | 8               |
| Coyote        | 050               | 214            | 72  |                  |                 |
| St. George    | 089               | 709.3          |   | 150              |                 |
| Bishop        | 279               | 701.1          |   | (1)              |                 |
| Inyokern      | 224               | 689.8          |   | (1)              |                 |
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(1) No signal/noise.



# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Sanford DATE 10/26/58 TIME 1020 Z

YIELD 4.9 kt BURST HEIGHT 1500 ft. LOCATION B-FF

APPARENT BLAST YIELD,  $W_a = 25.0$  kt,  $W_a^{0.4} 3.62$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| CP-1          | 323               | 61.7           | 11400   |                  |                 |
| BJY           | 338               | 103.3          | 7600  |                  |                 |
| Mercury       | 200               | 53.3           | 7600  |                  |                 |
| Las Vegas     | 135               | 325.4          | 312   | 156              |                 |
| Boulder City  | 134               | 437.9          | 1140  | 78               |                 |
| St. George    | 082               | 691.7          | 750   | 1920             |                 |
| Bishop        | 285               | 748.7          |   | 7.8              | 35.4            |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT DeBaca DATE 10/26/68 TIME 1600 Z

YIELD 2.2 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD,  $W_a = 8.93$  kt,  $W_a^{0.4} = 2.41$

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 187               | 47.5           | 15300   |                  |                 |
| CP-1          | 190               | 55.8           | 10380   |                  |                 |
| Mercury       | 178               | 155.6          | 468   |                  |                 |
| Las Vegas     | 144               | 430.2          | 15.3  | 78               |                 |
| Boulder City  | 140               | 532.9          |   | 456              |                 |
| St. George    | 091               | 709.2          | 348   | 1590             |                 |
| Bishop        | 277               | 697.8          |   | 9                | 72              |
| Inyokern      | 223               | 701.2          |   | 9.6              | 55.6            |
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# MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Chavez DATE 10/27 /58 TIME 1430 Z

YIELD <sup>(Not</sup> Released) kt BURST HEIGHT 52.5 ft. LOCATION A-3

APPARENT BLAST YIELD ,  $W_a =$  \_\_\_\_\_ kt,  $W_a^{0.4}$  \_\_\_\_\_

| MB<br>STATION | AZIMUTH<br>(DEG.) | RANGE<br>(KFT) | RECORDED PEAK-TO-PEAK<br>PRESSURE AMPLITUDE (MICROBARS) |                  |                 |
|---------------|-------------------|----------------|---|------------------|-----------------|
|               |                   |                | TROPO-<br>SPHERE  | OZONO-<br>SPHERE | IONO-<br>SPHERE |
| UCC           | 193               | 34.7           | 1476  |                  |                 |
| CP-1          | 194               | 41.8           | 1402  |                  |                 |
| Las Vegas     | 143               | 410.8          |   | 6                | 2               |
| Boulder City  | 139               | 521.9          |   | 8.7              |                 |
| St. George    | 089               | 709.3          |   | 13               |                 |
| Bishop        | 279               | 701.1          |   | 3.3              | 1.2             |
| Inyokern      | 224               | 689.8          |   | (1)              |                 |
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(1) No signal/noise.

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